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ABSTRACT

Resources for the Future, Inc. (RFF) is a nonprofit, tax-exempt corporation headquartered in Washington, D.C. RFF's purpose is to advance research and education in the development, conservation, and use of natural resources, including improvement of the quality of the environment. Most of its programs are carried out by resident staff, but a few are supported through grants to universities and other nonprofit organizations. Most studies are in the social sciences and are broadly concerned with relationships of people to the natural environment. Provided in this report is a selected representation of RFF's research programs and activities, concentrating on new projects and completed work. Programs and activities are described under the following headings: center for energy policy research (energy/national security, energy sources/technologies, integrative reviews, mineral economics and policy); quality of the environment (environmental assets, produced assets, environmental policy); renewable resources (food/agriculture, forests economics and policy, Federal lands, climate, workshop); and books in brief (describing five books and seven research papers, arranged alphabetically by author); and public affairs. Also included is a presidential essay ("Information, Communication, and the Policy Process" by Emery N. Castle, RFF president), financial statements, and information on Fall Forum, Wednesday Seminar Series, staff changes, and outside staff activities/publications. (JN)

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RESOURCES FOR THE FUTURE 1982

Annual report

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Resources for the Future, Inc. (RFF) is a nonprofit tax-exempt corporation chartered under the laws of the state of New York, with headquarters in Washington, D.C. It was established in October 1952 with the cooperation of the Ford Foundation.

RFF's purpose is to advance research and education in the development, conservation, and use of natural resources, including the improvement of the quality of the environment. A majority of its programs are carried out by resident staff, but a few are supported through grants to universities and other nonprofit organizations. Most of its studies are in the social sciences and are broadly concerned with the relationships of people to the natural environment.

This report does not cover the whole of RFF's research programs and activities. Rather, it is a selective presentation, concentrating on new projects and on completed work, with special emphasis on the twelve books and research papers published during the year. Inquiries are welcome concerning work in progress or additional details of programs reported here.

RFF's research and other work are supported by grants and contracts from foundations, government, and private industry. Details are available in the Financial Statements section beginning on page 96.

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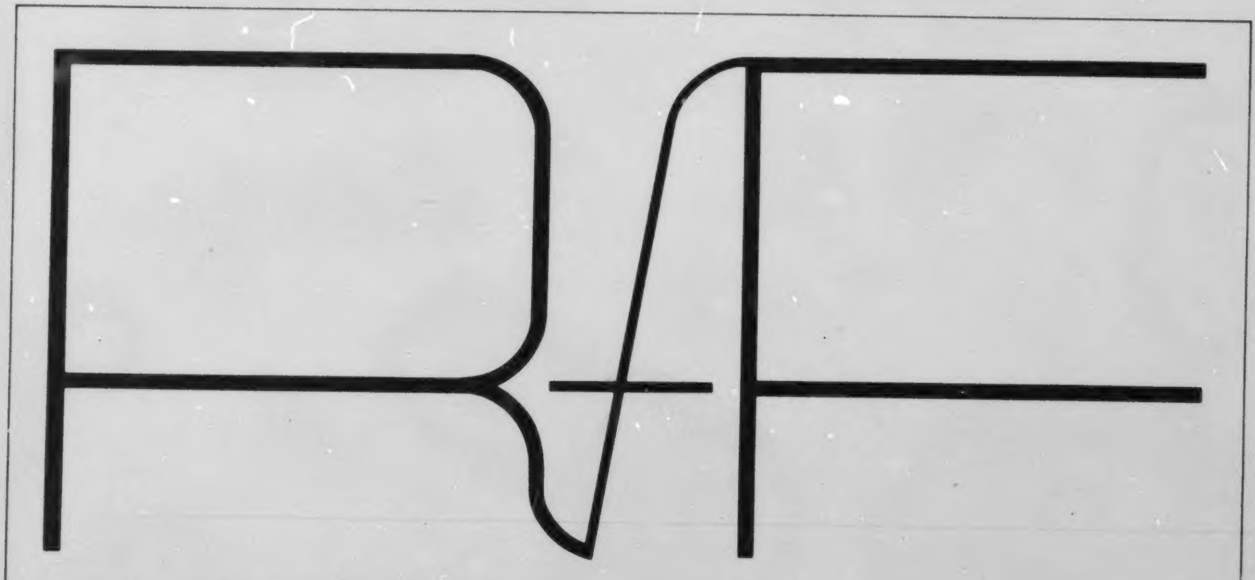
RESOURCES FOR THE FUTURE

Annual report

FOR THE YEAR ENDING SEPTEMBER 30, 1982



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* As of October 1982

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For an annotated listing of persons who either joined or left RFF during the program year (October 1, 1981–September 30, 1982), please see page 77.

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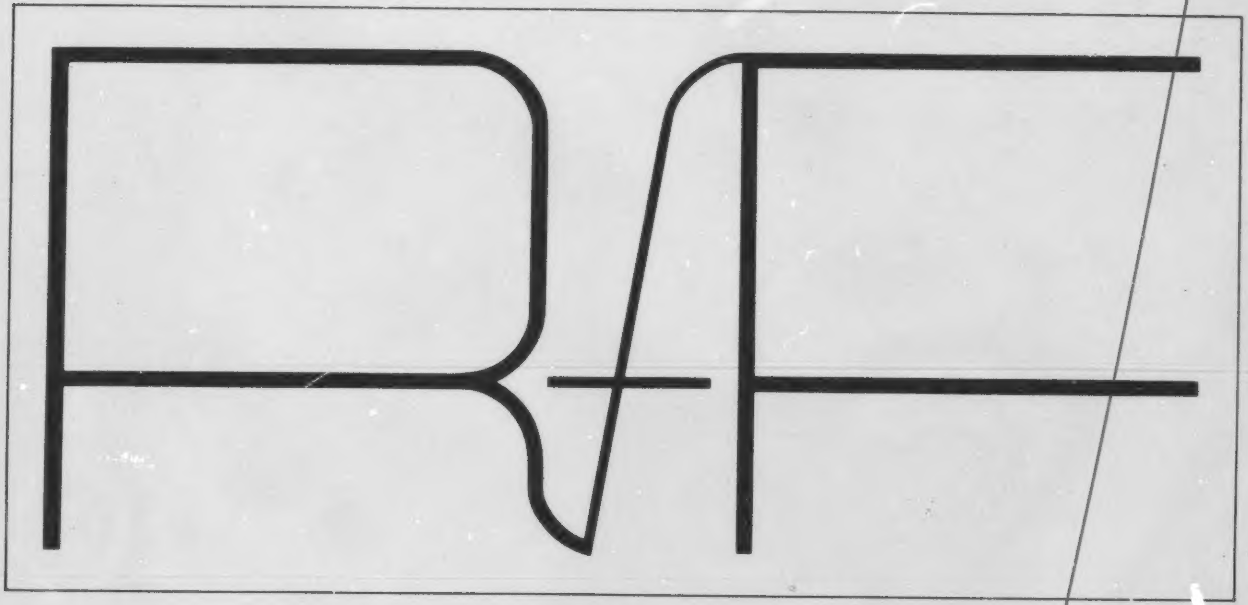

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INFORMATION, COMMUNICATION, AND THE POLICY PROCESS

by EMERY N. CASTLE

When asked how public policy is made in Washington, a colleague replied, "As near as I can tell, the policy-making process is much like a competitive market: Every participant has an influence, but the effect of any particular person is indiscernible."

The analogy is overdrawn. President Reagan's influence on those public policy matters of interest to him is hardly imperceptible. Nor does Secretary Shultz's position on foreign policy carry only average weight. Nevertheless, the basic point holds: what emerges as public policy in a democracy is the result of many influences. Even in retrospect it usually is impossible to measure or even to identify all the factors that cause a particular outcome, especially if the result is less than successful. As President Kennedy remarked on the occasion of the Bay of Pigs debacle, "Victory has a thousand fathers, but defeat is an orphan."

Because the policy process is so complex, it helps to consider how it is best served by policy analysis—those efforts to organize and present information and evidence for the specific purpose of assisting those who make decisions about public policy issues, or who serve the decision process in other ways. Some policy analyses are launched to bring about a particular outcome; others—RFF's among them—strive only to inform and elevate the policy debate. A steady stream of both kinds of material on a wide variety of subjects flows constantly from special interest groups, from think tanks, and from universities. Does such material serve a useful purpose? To whom should it be directed? How should it be presented? Can the results be measured even in rough terms? These questions occur frequently to those of us whose task it is to use analysis to serve the policy process.

Policy analysis distinctions

Public policy analysis ought to be distinguished from research undertaken to add to basic knowledge, even if that research turns out to have important public policy benefits. For example, during the 1970s this country badly needed consensus on energy policy. Several studies were mounted to discover such a policy and their results were advanced in the conviction that a contribution had been made to that end. Indeed, many of these studies offer examples of policy analysis at its best. On the other hand, great contributions to energy and other public policy may derive from research intended to expand the borders of knowledge rather than to serve the policy process directly. Generally, public policy analysis emphasizes synthesis, whereas basic research (almost always) uses analysis to focus on discrete subjects. RFF always has done both and will continue to do so.

Another useful distinction can be made between the intellectual resources policymakers bring to a problem and the evidence that comes to their attention as they work on it. Prior formal and informal education may be quite general and mainly influence an individual's public policy philosophy and broad approach to policy problems. Or policymakers may bring detailed knowledge to a particular problem. Especially in the latter case, basic researchers and classroom teachers may have considerable delayed influence on the shape of public policy, and even may contribute more to policy outcomes than does information developed on the scene. Again, RFF has been useful in both ways. We reach not only policymakers in Washington, but also professors and students in classrooms across the country. Indeed, it is a rare graduate program on natural resources or the environment that does not make significant use of RFF publications.

The wide range covered by the term *policy analysis* is matched by that for *policymaker*. One thinks first of senators, congressmen, officials in the executive branch, or Supreme Court justices—the people who vote on laws, issue executive orders, and make rulings. But these people are, of course, aided by many others who do less visible but very important work—the congressional staff member whose research leads to the formulation of laws, the oft-maligned bureaucrat whose decisions determine how policy decisions will be translated into action, and the Supreme Court law clerk, to name a few. The kinds of materials that serve these different needs often vary greatly.

Many actors, many forms of communication

Given policymaking's complexity, its multiple sources of information, and the several groups that need reliable information, it is not surprising that many means of communication can be and are employed to serve the process. Graduate students who may one day hold policy-making positions rely for information on books and intellectual exchange with professors and fellow students. Congressional staff workers, often with little time for lengthy books, depend on expert witnesses, small group-discussions, and relatively short, highly focused written material. Similarly, books may be too time-consuming for civil servants, but briefer written materials that address their areas of concern are valuable, as are workshops, conferences, small group discussions, and consultants, whether formally employed or not.

Public opinion

Public opinion counts. Government officials—whether elected, appointed, or hired through Civil Service—ignore polling results on public policy issues at the peril of their jobs. Yet the kind of information and the type of communication likely to influence public opinion often differ greatly from what is most valuable to the people who shape, apply, or interpret public policy. Because public opinion counts so heavily, democracies face a thorny problem—the difficulty of translating the results of sophisticated research into a form that is both comprehensible and useful to the general public. Yet this is the kind of knowledge that should be reflected in public policy. That it frequently is missing is testimony to the depth of the dilemma. That a yawning gap can and does exist between verifiable knowledge and public perception is frustrating and often exceedingly costly.

RFF and public policy

Resources for the Future was founded thirty years ago to discover and communicate knowledge about natural resources, including the environment, to better inform public policies affecting them. This goal is as valid in 1982 as it was in 1952, but the ways we accomplish it and their effectiveness may vary as circumstances change; they are under constant scrutiny and are adjusted accordingly. It is appropriate that on our thirtieth anniversary we take a searching look at ourselves to see if we are doing all we can to be of effective service.

The hallmarks of RFF research have been:

Nonadvocacy. RFF grinds no ideological axes, does not lobby, takes no positions as an institution, and makes no attempt to further or frustrate any particular cause or policy. Staff members are free, of course, to report their results and express their judgments about public policies even though such findings may be highly controversial. Indeed, controversy comes with the territory when important matters of public policy are addressed.

Each succeeding year seems to provide less time for reflective thinking by those responsible for public policy.

Identification and analysis of fundamental natural resource, energy, and environmental quality problems. For example, RFF has been a pioneer in:

- The role of energy in the economy
- Economics and environmental quality
- Outdoor recreation as a growing and legitimate use of natural resources
- The economics of natural environments.

A multidisciplinary approach to problem solving, with a major emphasis on economics.

We have communicated our research results in scholarly books and professional journals; in seminars, workshops, and formal conferences; and through staff participation in various public and professional service activities. We have delivered congressional testimony, responded to requests of the executive branch of government, given speeches and lectures, and taken on committee and task force assignments.

Changing times

Several forces are placing pressure on our traditional approaches. Perhaps chief among these is declining support for public policy research and education. Reduced government funding for these purposes has increased the competition for support from foundations and the private sector. But these private funders generally are less interested in fundamental problems than they once were. Indeed, funders of all types now are more interested in applied research and education—work that has immediate impact.

Each succeeding year seems to provide less time for reflective thinking by those responsible for public policy. Will the printed page—especially books buttressed by supporting data and detailed reasoning—be an effective vehicle in such a context? This question is especially cogent in the context of the high and rising costs inherent in scholarly publishing.

Americans are reputed to be great devotees of conferences and conventions, but it seems to us that the formal conference is less popular than it once was. Of course, this may indicate a kind of success. Total attendance may well be up, but so many organizations and groups stage conferences on such a wide range of subjects that participation at any one gathering may be limited.

During this past year several of us at RFF—staff and Board members alike—have discussed these trends and their implications for our program. Our aim is to respond to contemporary need while emphasizing those activities in which RFF is especially strong. This means that part of our approach will be relatively unchanged. But already we have made significant adjustments elsewhere and more will be made.

Strength maintained

If an institution takes positions, it invites skepticism when its findings coincide with its prior public posture. And institutional party lines surely have a chilling effect on a research staff's inclination to look for the truth in one direction versus another. So RFF has taken no positions, and will continue to adhere strictly to the principle of nonadvocacy. To reiterate, however, no advocacy does not necessarily mean no controversy. RFF's work always has generated a certain amount of controversy—sometimes simultaneously from opposing sides of an issue—and we expect that to continue. But this kind of contention is evidence that the subjects being investigated really matter to someone, and that policy problems, by their nature, seldom are resolved by research alone. We continue to shun advocacy not because of tradition, but because we believe that by so doing we can be of the greatest public service. A panoply of special interest groups, many of which do excellent work, promote particular points of view in Washington and throughout the country. We believe there is a unique niche for an organization that originates nonproprietary information and is not motivated by desire to advance a particular cause.

In RFF's three decades many resource and environmental problems have called for general analysis and the identification of possible approaches to a solution, and we will honor our historic role of addressing and analyzing important emerging problems likely to affect public policy. Support for such basic work has declined, but we believe it is badly needed, perhaps even more so now than in the past.

In particular, the nation now faces a second generation of problems that require detailed analysis, and this often means highly sophisticated research on, say, estimating the benefits of policies designed to improve the

RFF research is becoming more closely oriented to the needs of those who use research results.

quality of the environment. This is not the stuff of best-sellers: frequently only a few specialists in government, industry, and academia need this kind of work (or can even understand it, for that matter). Yet it is very important to this group of people, and we are proud that RFF has one of the few groups of scientists capable of developing such material.

In addition, a clear demand exists for RFF talents and approaches to less fundamental problems, and for efforts that draw together and focus research findings and knowledge on current problems. The just-published *Current Issues in Natural Resource Policy* is an outstanding example of this kind of synthesis.

We will continue our multidisciplinary approach. Indeed, we hope to strengthen our competence in the natural sciences and in the social sciences other than economics. This, of course, is difficult in the existing funding climate, which makes us all the more pleased that the Andrew W. Mellon Foundation has made a three-year grant to permit us to start a program of natural science resident fellowships. We also are bringing in on a regular basis seminar speakers from the natural sciences and technology.

But if certain traditional RFF strengths are being maintained, significant changes are occurring in other respects—new approaches to research, new relations between our people and participants in the policy process, and additional means of communication. While these developments still are evolving and more change can be expected, certain patterns are clearly discernible.

New research programs

RFF research is becoming more closely oriented to the needs of those who use research results. The following three programs are good examples of efforts that incorporate new relationships and new approaches to relate research—some of it quite basic—to policy needs. Each involves research users in research planning, each goes beyond the printed page in communicating its results, and two of the three are international in scope.

Forest economics and policy. Although RFF long had done work in this area, the program we established in 1977 set a pattern because separate efforts were gathered together in a cohesive whole and financed by a combination of private sector, government, and foundation funds, with the Weyerhaeuser Company Foundation and the U.S. Forest Service leading the way. A broadly constituted advisory committee advises us on the research and educational program, and we seek interaction with people in industry, universities, and in government.

The interest generated by the program's research results is impressive. Indeed, at times we are almost overwhelmed by the requests for testimony, speeches, and consultation. This level of interest is sustained by reliable research and knowledgeable people. But it clearly is stimulated by the broad funding base and by the regular involvement of people outside RFF in program planning and in the communication of research results. Because of our success with the Forest Economics and Policy Program, we have launched two additional efforts in this same tradition—a year-old Food and Agricultural Policy Program and a brand-new program in Mineral Economics and Policy, which is jointly sponsored by the Pennsylvania State University.

Expanding the national accounts. The natural environment generates many valuable services that are not measured by conventional national economic accounting systems because these services are not bought and sold in markets. The national accounts thus are misleading indicators of social well-being in that they fail to reflect both the environment's assets (the value of, say, clean air and water) and its liabilities (damages attributable to pollution). The gap between reality and what is measured is a source of serious concern to policymakers throughout government who need data that display all relevant relationships and that cover the full range of policy issues.

RFF researchers have been working on ways to expand the national accounts to incorporate nonmarket goods and services. The data they have assembled allow analysis of the links between industrial or household activity, the effects of this activity on pollution generation, and the effects of governmental policies to reduce pollution on the sectors' costs. Because national accounting principles require that all activity be accounted for, this work has permitted analyses of the national implications of policy that are impossible with data that apply only to a few selected industries or lack complete geographic coverage. For example, the effects of a national policy to control industrial water pollution cannot be assessed

Disruptions in supply are the most serious of all energy problems: basic economic security and peace itself are directly at stake.

without accounting for the pollutants generated by nonindustrial agricultural, urban, and household sources. And a national assessment clearly cannot be based on data applicable to only a selected number of geographic regions.

The data sets assembled by RFF have been used by the Environmental Protection Agency, the Department of Agriculture, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration to address a wide variety of policy issues. These include the benefits of industrial water pollution control, the likely effects of agricultural sediment control on water quality, the changing patterns of industrial water use nationwide, and the effects of economic activity on the nation's coastal waters.

Energy and national security. Of all the present and potential energy problems, disruptions in supply are the most serious in that basic economic security and peace itself are directly at stake. In a joint project sponsored by the Department of Energy, RFF and the Brookings Institution are studying the fundamental issues surrounding unstable oil supplies and their implications for U.S. economic and foreign policy.

Brookings is looking at ways to lessen the probability, size, and duration of disruptions, and RFF is investigating how to reduce the vulnerability of U.S. and other economies to disruptions that nonetheless might occur. The research is designed to yield a basis for U.S. policy options. For example, we have been assessing the private response to the Strategic Petroleum Reserve: since additions to the government reserve discourage private inventory build-ups (the opportunities for profit during a disruption are lowered), government programs need to be designed accordingly.

The joint energy and national security program is a three-year effort, but we believe that these topics will require continuing attention and plan to continue the work. Energy security planning is among the most crucial resource-related tasks of government, and this joint research strengthens the analytical base from which it can proceed.

Expanded staff activities

Our people are becoming increasingly involved in task forces, advisory committees, discussion groups, and other bodies formed to study particular problems. Costs and hazards are inherent in this sort of activity, of course: a participant finds it more difficult to maintain objectivity and perspective than does an observer. Furthermore, we must pay the cost of such activities from institutional funds. Most supporters wish to underwrite work on particular projects, not general educational activities.

But if the costs sometimes are high, the benefits are obvious. Research stimulated by such a process addresses real needs and fills information gaps uncovered in the give and take of discussion. Moreover, research results are likely to be used because they are fed directly into the decision process. Pages 79–88 of this report detail an extensive list of diverse public service activities being performed by RFF staff members. It is heartening that so many of our people are being called on so frequently by such influential groups, and we expect many new research activities to flow from their experiences.

Effective communication

Our society is in the midst of an information revolution. Electronics now make it possible to collect, process, and transmit vast amounts of information at very low cost. Such information even can be computer-interpreted according to preestablished rules. But the analysis required for many public policy needs cannot be made routine. The powerful new technologies must be supplemented by the power and flexibility of human interpretation and communication.

At RFF, therefore, we are employing electronic technologies as tools in every area—from econometric modeling to manuscript composition to management information systems—but books will remain our principal and distinctive product. RFF books and research papers are used extensively in classrooms, in research institutions, and indeed wherever there is serious discussion of resource and environmental policy. We are proud of RFF's historic role in graduate education, and we intend to preserve it. As suggested earlier, the prior knowledge that policymakers bring to an issue may be more important than what they can pick up in the hurly-burly of the policy arena.

But we have not concentrated exclusively on graduate students, faculty members, and other specialists, and more popular fare has been a growing part of our publications program. For the immediate future, we are working to identify particular audiences and to address them directly. This means that some books will be written for a broad audience and others for spe-

Advocacy has a valuable place in a democracy, and this is as true in the environmental arena as in any other.

cialists. Some will be theoretical and technical, and others will be accessible to any literate person.

In addition to books and research papers, we communicate research findings via more informal approaches and we intend to emphasize these in the years ahead. For example, we hope to expand the frequency, coverage, and readership of our periodical, *Resources*, now published quarterly and distributed free of charge to more than 22,000 readers. Edited for students and the interested public as well as for researchers and policy specialists, *Resources* has drawn unsolicited praise for its quality and usefulness. Similarly, we now produce a half-dozen or more programs each year for the FOCUS series of public affairs programs. Broadcast nationwide over more than 225 public radio stations, FOCUS shows reach thousands of listeners who may never read an RFF book. And plans for greater use of television are in the works.

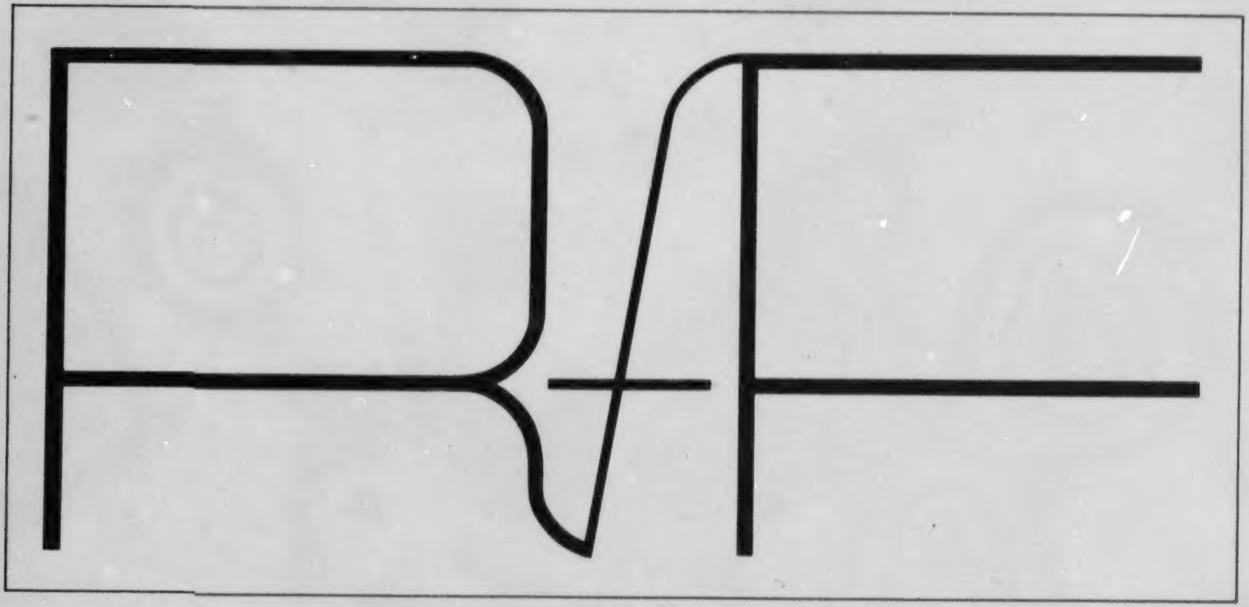
RFF always has had an ambitious program of workshops, conferences, and other group meetings. Based on recent positive reaction to informal smaller meetings, we will become more active with round tables and seminars that involve a broad mix of people from government, industry, and academia. No doubt we will continue to sponsor formal conferences, complete with published proceedings, but flexibility will distinguish our in-person efforts just as it does our approach to other forms of communication.

Saving the world

Many organizations—perhaps especially those concerned about natural resources and environmental quality—are founded to help save at least a small corner of the world. Spurred by threats to animal and plant species and to natural systems in general, scores of national and local groups boasting millions of members labor and lobby for dozens of special causes. Though once belittled as posy-pickers and now decidedly out of favor with the Reagan administration, environmentalist organizations nevertheless have achieved a substantial degree of political clout. Of course, no heterogeneous collection of people is free of foolishness, and environmentalists have pushed their share of dubious notions, but by and large they have earned respect as honest and effective champions of their causes. Advocacy has a valuable place in a democracy, and this is as true in the environmental arena as in any other.

But advocacy's place, however important, is not RFF's place, as I hope I have made clear. Rather, we try to discover verifiable knowledge and to place it in the hands of those whom society has entrusted to make decisions affecting natural resources and environmental quality. In Aaron Wildavsky's apt phrase, we are "speaking truth to power," though we are well aware that neither truth nor power is immutable. Truth is only what has not yet been refuted, and power—especially political power—is so transitory that historic electoral landslides can be reversed by the next election. Yet we are obligated to do the best we can—to enlarge the frontiers of knowledge, to educate both policymakers and the public, and to inform the national debate and, indeed, international deliberations. RFF could not save the world, even if we saw it as our mission to try. But, as I wrote in these pages shortly after becoming president, we do intend to make a difference.

The year's work in review



CENTER FOR ENERGY POLICY RESEARCH

Most past and present energy studies focus on oil, or natural gas, or electricity, or on some other source or technology. But from the start in 1952, RFF scholars have integrated the individual strands of energy that others approach separately. Indeed, RFF's first major publication was *Energy in the American Economy, 1850–1975* (1960), which combined in one volume both a history of U.S. energy use and production and an unprecedented detailed estimate of the adequacy of energy sources for the next twenty years. That study's concepts and analytical approaches established a new state of the art for researchers throughout the energy field. Similarly, *Energy in America's Future* (1979) integrates all facets of energy in the changed situation wrought by the 1973–74 oil embargo and subsequent price hikes, and it too is acclaimed as a landmark study.

But approaching energy as an integrative and unifying concept does not necessarily mean that every RFF study results in a massive, all-inclusive volume. Many narrower studies are initiated that focus on specific energy sources, uses, policies, and geopolitical contexts, and the report that follows is organized along such lines: energy work at RFF is a rounded whole made up of separate but related parts.

No attempt is made here or in the reports of the other two RFF research divisions to detail every project or activity of the 1982 program year. Rather, in reporting major studies undertaken or completed or key progress made in continuing projects, we seek to convey the flavor and much of the substance of the year's effort.

ENERGY AND NATIONAL SECURITY

In a joint, three-year project, RFF and the Brookings Institution are studying the basic issues inherent in unstable foreign oil supplies and their implications for U.S. economic and foreign policy. Brookings is concentrating on ways to lessen the probability, size, and duration of disruptions, and RFF is analyzing how to reduce the vulnerability of U.S. and other economies to cutoffs in supply that nonetheless do occur. The research is supported by the U.S. Department of Energy, and is designed to yield a basis for U.S. policy options.

International cooperation

The energy security policies undertaken by any oil-consuming nation inevitably affect other consuming countries through their effects on the world price of oil. The presence of these "policy externalities" suggests that consuming countries could mutually benefit by coordinating their policies to encourage efforts that have favorable external impacts and to limit actions with adverse consequences for other countries.

In the first stage of research on international coordination of energy policies, Douglas R. Bohi and Michael A. Toman examined the prospects for gains from cooperation and the obstacles to alliances among energy-consuming countries. Using the theory of noncooperative games, Toman derived a broadly applicable set of conditions under which policy coordination is mutually beneficial, relative to a situation in which cooperation is absent: provided the policy externalities from each country's actions all are favorable (as with an import tariff) or all adverse, and that institutional or political constraints do not unduly limit policy flexibility, then the well-being of each importing country can be enhanced by undertaking policies that differ from those a country would pursue when acting only in its own interest.

That the mutually beneficial policy options differ from those that countries would pursue acting alone points up the principal difficulty in establishing viable alliances: in the absence of binding international legal agreements, incentives to "free ride" may be substantial, and in the presence of conflicting national interests the costs of establishing and monitoring international agreements may exceed the benefits of policy coordination. Indeed, a survey of cooperative game theory suggests that this theory has limited power to explain how consuming-country coalitions form, how gains from cooperation are divided, and how frictions among members are moderated.

Toman wrote two discussion papers during the year resulting from this line of research: "The Benefits of International Energy Cooperation: A Theoretical Perspective," and "A Noncooperative Equilibrium for State Dependent Supergames" (see page 72). Plans for further research include an application of the theoretical framework to assess the viability of existing International Energy Agency agreements and of alternative institutions.

Shockproofing the private sector

To many Americans, the energy shocks of 1973–74 and 1979–80 were made manifest in the long lines at filling stations. Never mind that gov-

The center for energy policy research examines all aspects of energy policies and commodities and also maintains responsibility within RFF for work on nonfuel minerals and other materials.

ernmental allocation policies were the principal causes of gasoline queues and frayed tempers, nor that the new rules governing international energy production, pricing, and consumption played contributing roles in national and world economic recessions. For a number of citizens—perhaps a majority—the energy "crisis" *was* gasoline lines.

If there is a next time, for whatever reason, how can the country better prepare itself to deal with the relatively straightforward matters affecting gasoline allocation and with the more complex shockwaves that ripple through the economy, whether caused by cutoffs in supply or price hikes, or both?

Harry G. Broadman has begun an analysis of policies that reduce oil supply disruption costs and that restructure the economy to make it more resilient to oil price shocks. In particular, he is examining policies that can be implemented *before* rather than *during* disruptions. The objective is to provide practical guidance for the development of a collection of cost-effective instruments and decision rules that encourage an optimal amount of private sector preparation for oil supply disruptions.

Emergency energy demand reduction

What can policymakers do when confronted by cutoffs in foreign oil supplies, whether caused by wars, embargoes, or natural disasters? What options are available to influence the process by which demand and supply are brought into balance?

Many economists prefer to allow the market to function freely. Thus, the excess demand for petroleum products created by the supply shortfall will cause prices to rise and domestic production to increase until a new equilibrium is established.

Alternatively, as in 1979–80, prices can be controlled and petroleum can be allocated among consumers by the federal government. In effect, gasoline lines or gasoline ration coupons rather than prices serve as the allocating mechanism to choke off excess demand.

Finally, demand can be restrained directly through contingency programs that are put into effect during a petroleum supply disruption. These include gasoline purchases on the basis of odd-even auto license plate numbers, restricted operating hours for gasoline stations, prohibition of weekend gasoline sales, emergency building temperature restrictions, and so forth. Such policies have been viewed as desirable because they can be applied to uses—for example, weekend driving or pleasure craft use—that are seen as discretionary and less productive.

Aside from the administrative costs of designing, implementing, and enforcing such programs, there is a real welfare loss to users who would be willing to pay higher prices for access to scarce petroleum products but who must consume less because of contingency measures. However, the costs may be more than compensated for through the macroeconomic benefits of lower prices and retained national income relative to free market price allocation.

Scott A. Noll is exploring the costs and benefits of emergency energy demand restraint measures compared to other policy options. The major purpose of the analysis is to evaluate to what extent the price reduction and energy savings benefits of restraint measures compensate for the administrative and relative efficiency losses that accompany these nonmarket approaches to scarce petroleum allocation, and under what conditions other policies might be preferable. In a companion study, Michael J. Coda conducted a survey of regulations open to policymakers who must cope with allocating scarce supplies. His discussion paper, "Emergency Demand Restraint Measures: A Descriptive Survey," (see page 72) offers a catalog of such measures.

Oil import premium

Many energy policy analysts argue that the true cost to society of U.S. oil imports is greater than the world oil price because each additional barrel of imported oil raises the price of oil and increases our economic vulnerability to disruptions in world oil supplies. Therefore, the market-determined price of oil will not lead to levels of oil imports, production, and consumption that are in the nation's best interest. This difference between the social and private costs of imported oil has become known as the "oil import premium."

In two discussion papers, "Social Cost of Imported Oil and U.S. Import Policy" and "Tariffs and the Economic Costs of an Oil Disruption" (see page 71), Douglas Bohi and W. David Montgomery subject the idea of an import premium to careful scrutiny from the perspective of economic theory, and evaluate instruments to develop more effective public policy. This analysis was extended and brought to a conclusion in a major study of the oil import premium question entitled *Oil Prices, Energy Security, and Import Policy*, to be published in November 1982.

In a discussion paper, "Review and Analysis of Oil Import Premium Estimates" (see page 72), Harry G. Broadman finds that the premium estimates span a wide range, from near zero to well over $100 per barrel. Broadman's analysis of the oil import premium concept as well as his evaluation of the various estimation methodologies lead him to conclude that it is likely that oil imports *do* cost society more than the market-determined price, but that the magnitude of the premium probably is quite small and at the conservative end of the range of estimates.

Stockpiling

Stockpiling a commodity in the face of possible interruptions in supply is one of the oldest and most effective devices available to public and private decision makers. It is no surprise, then, to find that the Strategic Petroleum Reserve is a cornerstone of U.S. energy security policy. But to determine both the optimal size of the reserve and how rapidly to draw upon it, government planners must undertake the difficult tasks of estimating the likelihood of an oil supply disruption, the severity and duration of an emergency, and the response of domestic oil demand to sharply increased prices. Planning for the reserve is further complicated by the fact that if the policy is successful in limiting the oil price run-up, then incentives for the private sector to build inventory in anticipation of an emergency are reduced.

In the first of a series of studies on efficient stockpile management, David Montgomery and Michael Toman examined the interactions between private and public stockpiling decisions. Using a simple theoretical model and the assumption that private decision makers correctly anticipate the effects of government stockpile fill and release on the price of oil, Montgomery and Toman develop a framework for assessing how private stocks are displaced by government stocks. They show that the total of private and public stocks, in the absence of cooperation between the two sectors, is lower than the level that would maximize the social benefits of stockpiling in limiting price shocks. Thus, the analysis indicates that while a strategic reserve is an important element in emergency preparedness, an additional barrel in the reserve does not add a full barrel to the national capacity for coping with supply disruptions, and measures to encourage private inventory building in addition to the creation of a public reserve are justified.

In a discussion paper, "The Strategic Petroleum Reserve: Progress After Seven Years" (see page 72), Sandra Glatt examines the existing Strategic Petroleum Reserve program by focusing on major matters of contention. These include its size, appropriate type of fill, choice of storage facilities, drawdown and distribution plans, procurement policies, financing options, costs, and role of the private sector. The discussion highlights difficulties in implementing a large, complex economic and engineering program, born in a perceived "crisis," when the political will to carry it through fluctuates with every shift in perception of oil disruption risks. The author does not analyze motivations behind the decisions made, and does not offer an independent interpretation of the wisdom of actions taken or deferred. Instead, she reports the facts, describes the issues, and traces the effects of actions on outcomes.

Plans for further research on the stockpile question are to extend the analysis of public–private interactions to the timing of drawdown decisions, to develop a numerical simulation model for sensitivity analysis of policies, to investigate more deeply the impact of oil price uncertainty on planning and expectations, and to address issues pertaining to financing options for the reserve.

ENERGY IN THE DEVELOPING WORLD

The industrialized countries have been hit hard by the oil price hikes of 1974 and 1979–80. Recession, balance-of-payments problems, and severe effects in basic industries have been some of the results. Though the oil-importing developing countries as a group managed to weather the 1974 oil price increase better than expected, they, too, are now experiencing major difficulties. Development itself is under threat, external debt is soaring, and the international financial system is straining under the load.

RFF has mounted a wide-ranging series of projects that focus on the energy-related problems of the developing world.

Forecasting energy consumption

Forecasts of energy consumption and supplies are essential to energy planning. Overestimating future consumption levels, leading to overinvestment in highly capital intensive energy facilities, could divert scarce capital resources from more productive development projects. On the other hand, underestimating future consumption leads to energy shortages that require a long time to correct.

Under a contract from the Office of Long Range Assessment and Research of the U.S. Department of State, Joy Dunkerley and John E. Jankowski, Jr., with R. K. Pachauri and Alan Poole as consultants, completed a study of future energy consumption in India, Brazil, the Republic of Korea, and Mexico. In each of these countries the rates of increase in energy consumption in the latest energy forecasts is lower than those made in the past, and a critical analysis of these recent projections suggests that they may still be too high. Much depends, however, on government energy-pricing and conservation policies. If current plans are fulfilled, oil imports could rise, although at a somewhat lower rate than presently projected for the next decade. Even so, the oil-importing developing countries as a group will account for most of the total increase in world oil imports over this period.

A common feature of the projections for the four countries is the continued rapid increase in electricity consumption, which implies a rising share of electricity in total energy use. By the end of the century, for example, it is estimated that electricity could provide 30 percent of total final energy consumption in Korea and 40 percent in Brazil. Such a high share at still relatively low levels of income raises major questions about the availability of markets for this electricity.

Energy demand prospects

Two related projects are under way. In the first, under a contract with the energy department of the World Bank, Joy Dunkerley and William Ramsay, assisted by Holly Stallworth and Caroline S. Bouhdili, are reviewing energy demand prospects in selected developing countries, including current and projected energy demand through 1995 disaggregated by major fuel—oil, natural gas, coal, and primary and thermal electricity. The main trends and the assumptions behind these trends, such as rates of economic growth, trends in energy prices, changes in sectoral consumption patterns, conservation policies, and interfuel substitution will be discussed and analyzed. The research team will identify the main sources of uncertainty affecting demand projections, such as supply constraints and institutional or infrastructure-related delays in implementing programs, and they will address any significant and systematic differences between developments and issues in larger countries and in selected smaller developing countries.

Analyzing common problems

In the second related study, Joy Dunkerley and William Ramsay are analyzing energy problems of countries receiving assistance from the U.S. Agency for International Development. Sponsored by AID, they are identifying similarities in energy-related problems in certain groups of countries. The topics being addressed include not only similarities among countries in energy demand, but also the effects of oil imports on balance of trade and possible tradeoffs between production and export of domestic goods versus the use of domestic resources for energy purposes.

Biomass

Dunkerley and Ramsay also are the principal investigators in a new project funded by the U.S. Department of Agriculture under AID sponsorship This program will investigate the use of energy from biomass—such as wood, crops, and animal and crop wastes—with the goal of producing an integrated guide to the subject that will help resource owners and national planners in Third World countries. The project will cover all aspects of the topic, including energy demand, land use potentials, possible crops, technologies, environmental quality, types of organization, markets for products, and the role of bioenergy projects in national economies.

In a brief look at a particular country, Ramsay was a member of an AID biomass reconnaissance team that investigated energy problems in the Sudan. During site visits in April 1982, the team examined the role of biomass, including trees, water hyacinth, and sugarcane, in satisfying future national energy requirements.

Oil proliferation

Exploring for and developing petroleum resources in non-oil developing countries (NODCs) benefits not only these countries but also enhances the energy security and prosperity of all oil importers. What can be done to stimulate such investment? Is there a need for public sector intervention?

A cost-effective policy that brings about an optimal amount of petroleum investment in NODCs must derive from an understanding of the determinants of petroleum exploration and development activity within NODCs and among international petroleum companies. To this end, Harry Broadman and Joy Dunkerley have begun a multi-year project to systematically assess the relative importance of such factors as resource potential, economics, institutions, and politics. In particular, they are developing a theoretical framework comprised of hypotheses that can explain the pattern of oil exploration and development activity across NODCs and why some petroleum companies are more likely to engage in such activity than others. After assembling the appropriate data, the framework will be subjected to statistical analysis to test the various hypotheses. Supplementing this effort will be in-depth case studies that focus on the interaction between NODC host governments and international petroleum firms, including analysis of contractual relations, tax and other economic considerations, and political risk.

This work is supported by the U.S. Departments of Energy and State.

The ARDEN project

RFF's comprehensive, three-year effort to improve understanding of problems and possibilities of developing countries as energy prices rise came to a successful conclusion during 1982. Supported by the Agency for International Development under a Cooperative Agreement and dubbed ARDEN AID RFF Development and Energy), the project provided funds both to carry out research at RFF and to fund researchers in the developing world. William Ramsay was project leader, Joy Dunkerley was co-principal investigator, and Julia Allen, Douglas F. Barnes, John Jankowski, and Scott Noll were members of the project staff during the last year.

Work under the project successfully filled major gaps in this area by collecting essential data and performing basic analyses of energy policy problems in the Third World. In addition, through subgrants to institutions in developing countries, it stimulated research capabilities in those countries. Indeed, the development of successful working arrangements with institutions abroad—in spite of language barriers and long distances—was one of the most rewarding parts of the project.

The final year of ARDEN work covered three major areas. Douglas Barnes and researchers in India, Colombia, and Indonesia produced studies on the impacts of rural electrification on agriculture, industry, and households. Joy Dunkerley led the work on energy conservation, which involved work at RFF and studies from collaborators in Ecuador, Colombia, and Kenya. William Ramsay supervised work on biomass fuels, including work at RFF on the economic effects of alcohol fuels and outside studies in Costa Rica, Brazil, and India. Julia Allen and Douglas Barnes investigated effects of community forestry projects and Allen collaborated with outside investigators on forestry projects in Tanzania and the Sudan. In addition, Allen did original work on environmental effects of forestry projects using data she collected in Tanzania.

Most of the final year of ARDEN work is reported in some detail in a series of discussion papers. (A complete list is provided under "Energy in Developing Countries Series" on page 71 of this report.)

ENERGY SOURCES AND TECHNOLOGIES

Natural gas policy overview

Regulation of the field price of natural gas entered a new phase with the passage of the Natural Gas Policy Act of 1978 (NGPA). That act brought sales within the producing states under regulation for the first time, removed some gas from control, designated some gas to be deregulated as of the end of 1984 and, for all regulated gas, determined price by statute rather than decision of the Federal Energy Regulatory Commission. How has the operation of the gas industry been changed and what further changes are in store? What will be the effects of the 1985 changes in NGPA provisions? What are the implications for efficient use of resources and for income distribution among sectors of the industry and consumers of the NGPA-mandated partial decontrol of natural gas prices as compared with the full decontrol advocated by some?

Milton Russell investigated these questions in research which he reported at a conference sponsored by the American Enterprise Institute. Among his conclusions was that, on plausible assumptions, full decontrol would improve the efficiency with which the economy operates and hence increase national output. A more surprising result of his analysis is that, to a first approximation, neither consumers nor producers as groups would be affected by full decontrol as compared with partial decontrol in 1985. But, income would be shifted *among* consumers and *among* producers. Similarly, some pipelines and distribution companies would be aided and others harmed under different decontrol scenarios. This analysis suggests that future political alliances based on self-interest will be substantially different than in 1978 as Congress considers whether to amend the NGPA or allow it to run its course.

Russell's research will be published in a forthcoming AEI volume. A prepublication draft was issued by RFF as a discussion paper entitled "Natural Gas Deregulation: Overview of Policy Issues" (see page 72).

Downstream natural gas issues

Much has been written about the likely impact of the Natural Gas Policy Act, relative to full wellhead price decontrol, on the level of prices at the burner tip, the distribution of income among the industry's participants, and the relative prices faced by, and quantity of supplies available to, the various gas-consuming segments. But although the *upstream* market will become increasingly free of price controls, utility-type regulation—both at the federal and state levels—of the *downstream* transmission and distribution sectors will continue. Yet in contrast to the attention devoted to comparing the overall efficiency and distributional consequences of partial versus full wellhead decontrol, little research has been done on fundamental changes in regulated downstream markets that are likely to be brought about by field price deregulation.

Harry Broadman and David Montgomery, assisted by Mary Beth Zimmerman, have produced a book-length manuscript that identifies four broad categories of potential changes in:

- The structure of pipeline markets and the nature of interpipeline competition
- Transactional arrangements between producers, pipelines, and distributors, including vertical integration, long-term contracts, and spot transactions
- The way regulated transmission and distribution companies set their prices and bid for gas inputs and in their capital investment decisions
- The downstream regulatory regimes themselves, including the carrier status of interstate pipelines and rules governing the allocation of costs into the structure of rates.

For each of these categories, a research design is derived from applications of the literature on modern price theory in order to permit an evaluation of the impact of these changes on economic welfare. This work is supported by Oak Ridge National Laboratory.

Gas from biomass?

In a paper commissioned by the Gas Research Institute, Sterling Brubaker of the Renewable Resources Division addressed the technological, policy, and economic factors governing the place of biomass-derived fuels in the nation's long-term energy mix, with particular emphasis on the outlook for biomass as a feedstock for gaseous fuels.

Brubaker concludes that—absent unforeseen technical developments—gas from biomass faces a range of strong competitors based on other energy sources. For example, the massive U.S. coal resources could, through advanced combustion and conversion technologies, provide in abundance any of the fuels available from biomass. Conservation and passive solar technologies are further alternatives.

Within the biomass slate of materials, Brubaker judges wood and grass, plus some field and logging residues, to be the likeliest candidates. Their principal advantages are that they need not compete in any serious way with the food system, and that they can be produced on a large scale.

Fossil energy

The Center for Energy Policy Research continues to cooperate and consult with the U.S. Department of Energy on fossil energy issues. As in past years, Harry Perry played the principal role in 1982 in the interaction with the Department of Energy.

Perry completed reports on three topics and submitted them to the Assistant Secretary for Fossil Energy. These include work to make current a report on fossil energy technology options to reduce oil imports, a critical review of several recent reports on U.S. steam coal export potential, and an analysis of a report by the International Coal Refining Company for markets for a solvent-refined coal (SRC-1) product. In addition, Perry reviewed the department's report on oil vulnerability and met with Fossil Energy staff members to discuss their possible role in any oil supply reduction.

Perry also assisted in a review of the different coal models that have been used to project both coal supply and demand, and he reviewed a proposed contract to further evaluate coal models.

At the request of the Assistant Secretary for Fossil Energy, Perry reviewed the part that fossil energy should play in discharging the department's responsibilities regarding the environmental impacts of synthetic fuel plants. The absence of any operating synfuel plants from which to learn and the sheer magnitude of the potential environmental discharges have led regulators to take a very cautious view of plant siting and the need for control technologies. Also for the Fossil Energy Division, Perry assessed the report on synthetic fuels prepared for DOE by the Engineering Societies Commission on Energy.

Finally, Perry prepared a detailed evaluation of the candidate gasification process for eventual use by the Synthetic Fuels Corporation in evaluating large-scale projects submitted to it for government participation. He also examined the fluidized-bed gasifiers currently being supported by DOE to determine the readiness of each type for commercial application and to assess its materials requirements for producing gas. As a result of these evaluations, DOE's "Base Improvement Targets for Fluidized Bed Gasification Systems Research" may be modified, and Perry has submitted a draft report on a possible task order on this subject to the department.

INTEGRATIVE REVIEWS

Looking beyond 2000

Most existing energy forecasts—and most discussions of future trends—focus on the year 2000. Yet many current and imminent decisions regarding research and development, technology, and investment depend on energy demands that will materialize after the turn of the century.

Sponsored by the Gas Research Institute (GRI), RFF is critically reviewing and analyzing studies containing energy projections beyond 2000 in an effort designed to improve GRI's long-term planning perspective and strategy. The project will result in a literature survey that compares and comments on selected studies with an emphasis on their assumptions, methodologies, and findings. This study is directed by Joel Darmstadter, with the assistance of Douglas McDonald.

Energy supply behavior

Nearly a decade after the first OPEC supply disruption kindled interest in the determinants of nonrenewable energy supply (particularly oil and natural gas) and spurred efforts to model energy supply, understanding of influences on supply behavior remains limited. Numerous gaps exist among the theory of resource supply, the data on supply behavior, and empirical techniques for combining theory and data. In addition, the theory provides an incomplete picture of market interactions between supply and demand decisions, and empirical studies often are weak in addressing the dynamics of supply and the impact of uncertainties and government regulations on producers' expectations and decisions.

With financial support from the Electric Power Research Institute, Douglas Bohi and Michael Toman have completed a book-length report, "Energy Supply Behavior: Theoretical and Empirical Problems in Nonrenewable Resources." In this work, Bohi and Toman use the theory of nonrenewable resource supply to illustrate the inherently dynamic character of supply decisions and the relationships among the exploration, reserve development, and extraction stages of the supply process.

Practical methods for incorporating these aspects of supply in an empirical model are discussed, as are gaps in data that require a reformulation of the theory to conform with available information. Bohi and Toman also discuss the importance to reliable supply modeling and estimation of sorting out interactions among demand, supply, and government interventions in the market; assessing the effects of changes in producer expectations and adaptation to regulations on supply decisions; and of distinguishing influences on aggregate supply from heterogeneous sources, such as differing geological attributes or input scarcity, versus influences on decisions at the level of the individual firm.

In additional work, Bohi and Toman have been commissioned by EPRI to write two survey articles on theoretical and methodological issues in modeling energy supply and demand.

Contributing to popular consensus

RFF scholars always have resisted the characterization of the various problems afflicting the national and world energy scene as a crisis. The "energy crisis" may be popular shorthand for headline writers and television newscasters, but it is a misnomer: crises come on suddenly and peak to a resolution, whether for good or ill, but the energy problems confronting society were a long time building and show no signs of abatement.

By now it should be abundantly clear that energy issues cannot be resolved by a plan, technological breakthrough, or even a stroke of good luck. Energy offers a chronic and changing set of difficulties with which society must learn to deal. Of course, good information, good analysis, and sensible decisions can help to set long-range goals that will be a useful guide as the nation copes with day-to-day questions. But there is no solution in the sense that, once selected, a course of action will take care of energy worries indefinitely—or even for a decade or two.

Joel Darmstadter, Hans H. Landsberg, Herbert C. Morton, and Michael Coda have completed a manuscript, to be published in mid-1983, that is designed to convey a popular understanding of the energy situation that to many seemingly changed overnight in the early 1970s. Their emphasis on the necessity to live with a continuing energy problem is one that has been relatively neglected in the tide of energy books published in recent years.

Recognizing the inevitability of continued dilemmas and strains over energy does not preclude managing energy affairs in more skillful ways. That opportunities to do so exist in some abundance is revealed in the authors' review of energy use and conservation trends, the energy resource base, research and development and energy-industry issues, and environmental impacts. They sift the knowns from the unknowns, the relatively agreed upon from the highly controversial, and they keep text, tables, and graphics as clear as possible. The result, it is hoped, will be a strengthened consensus on what constitutes the "energy problem" and what are some sensible ways of dealing with it.

As the foregoing suggests, this book is not written for the small fraternity of energy specialists. Rather, college students enrolled in survey courses on natural resource problems or science-and-technology; high school teachers keen on introducing energy topics in current-events classes; and membership organizations committed to pursuing and discussing resource and environmental policy questions are among those to whom the authors are speaking. Indeed, the book is designed to have something useful to say to all who are eager to gain some command over one of the bewildering issues of our time.

MINERAL ECONOMICS AND POLICY

The Center for Energy Policy Research maintains responsibility within RFF for nonfuel minerals and materials. Energy and materials historically have been related at RFF, and with good reason: for one, like nonfuel minerals, coal, gas, oil and uranium are mined; and second, energy is perhaps the pivotal factor that makes possible mineral extraction, transport, beneficiation, and final product manufacturing. And as ores decline in richness—the percentage that, say, copper represents of total ore mined in a site—additional energy can keep total production constant or even increase it. Thus, energy in effect can substitute for minerals, a fact that makes rising energy costs of keen interest to the minerals and mining industry, whether private or public, the world around.

Mineral Economics and Policy Program

The establishment at RFF of a formal Mineral Economics and Policy Program was one of the major stories of the year. The new program, headquartered within the Center for Energy Policy Research, is a joint undertaking of RFF and The Pennsylvania State University. Its co-directors—RFF's Hans H. Landsberg and Penn State's John E. Tilton—spent the first year building the program in substance, in funding, and in organization.

A first order of business was a review of stockpile philosophy, management, and policy, initiated under the direction of Raymond F. Mikesell of the University of Oregon. The nation's so-called strategic stockpile now is badly out of balance in terms of goals and actual holdings. Indeed, it would take several billion dollars in sales and acquisitions to bring it into line with goals. Accordingly, this is a good time to inquire anew into the rationale of the stockpile's role and goals, the decision rules governing its use, its relationship to the holding of private inventories, and the forms in which the material is most efficiently kept.

A study on the implications of the decline in U.S. smelting and refining capacity is a candidate for early consideration. Questions to be investigated are the impact on import dependency as imports change from raw to processed ores; the future of low-grade domestic ores; stockpiling requirements; local impacts as facilities close down; and the respective roles of environmental regulations, labor costs, age of facilities, and other factors in causing the decline.

Another project, funded by the Alfred P. Sloan Foundation, deals with the economics of minerals exploration. What are recent trends in exploration investment? Have there been geographic shifts, and if so, why? What materials are in the forefront of exploration activity? How do companies form their exploration policies? Is there a role for government, and what is it? These and related questions form the substance of the project to be undertaken by a small team of geologists and economists, guided by Tilton and Landsberg.

A funding drive was begun in late 1981, aimed first at the major mining companies and at foundations. By the end of the fiscal year, five companies had pledged from one to three years' general support of the program—RFF policy does not permit corporate funding of specific projects—and many other companies indicated sympathy with the program's research aims but declared themselves unable to support it at this time. The grant from the Sloan Foundation was made just after the close of the year.

An advisory committee has been established to help guide the program. In addition to Landsberg and Tilton, who serve ex officio, the membership is as follows:

Simon D. Strauss (Chairman), Consultant
Paul A. Bailly, Occidental Minerals
William Manly, Cabot Corporation
Bruce C. Netschert, National Economic Research Associates
Allen S. Russell, University of Pittsburgh
John J. Schanz, Jr., Congressional Research Service
Robert Solow, Massachusetts Institute of Technology

Minerals in the 1980s

Hans Landsberg has completed a report that identifies and analyzes the principal current concerns about the U.S. position in nonenergy minerals, with an emphasis on the metals. He begins more than thirty years ago with the President's Materials Policy Commission—the Paley Commission—which was an intellectual and organizational forebear of Resources for the Future, and ends with some legislative proposals of 1981 designed to put some flesh on the rather bare bones of past legislation that was long on general exhortation and short on specific prescription. The report, prepared at the request of and funded by the Oak Ridge National Laboratory, is "Minerals in the Eighties: Issues and Policies."

Landsberg suggests that the search for a "comprehensive national materials policy" is at best elusive and at worst a waste of time. Iron ore, cobalt, bauxite, and zinc, for example, share too few similarities to allow a jointly relevant and applicable policy. Yet a great deal of effort by the materials community has been devoted to fashioning just such a policy and, in addition, to seeking a place of high visibility in the federal government structure—preferably in the Executive Office of the President—where materials problems would come together and comprehensive policies would be formulated. Both attempts have been largely unsuccessful.

The report stresses that in most respects it is wrong to draw inferences for minerals from the recent history of energy: the dollar values involved and the structure of both producers and consumers differ radically between the two commodity sectors. Minerals comprise a vastly smaller portion of the U.S. economy than does energy, minerals stockpiling is relatively inexpensive metals—unlike energy—can be recycled, and there are other differences. Thus, the risk of cartels forming in the various metals is remote and even steep price increases can be accommodated with much less jeopardy to the economy than is true for energy in general or oil in particular.

Among the currently prominent issues Landsberg analyzes are the access to federal lands for minerals exploration and development; the status and role of the U.S. strategic stockpile; the questions of depending on imports from potentially insecure sources, especially southern Africa and the USSR, and of the assertion that the Soviet Union is engaged in a protracted "resource war" with this country; and the roles of materials substitution and of research and development. More broadly, Landsberg examines several options the nation might employ in both coping with short-term bottlenecks and long-term impending scarcities or supply difficulties.

QUALITY OF THE ENVIRONMENT

The work of the Quality of the Environment Division can usefully be viewed as falling into three categories. The first concerns *environmental assets*, such goods and services as clean air and water, recreational opportunities, and wilderness areas. Almost everyone would agree that environmental assets are valuable, but few would agree on specific values for specific assets. The difficulty arises in part because these assets are not bought and sold in markets and thus display no obvious price tags.

The second category of work concerns *produced assets*, the material and human capital produced by man and used in subsequent production. Characterizing and measuring the interaction of produced assets with natural resource products, such as fossil fuels, and environmental assets is a rapidly developing field of research.

Finally, the division continues to pursue projects in the area of *environmental policy*. The questions being asked include: How are environmental policies formulated and implemented? Do they accomplish what their designers had intended? If less than optimal, what kinds of policies might be more effective, or less expensive, or both?

ENVIRONMENTAL ASSETS

Expanding the national accounts

Environmental wealth contributes to human well-being in much the same way as other forms of wealth that commonly are measured in dollars. That is, while the goods and services it generates are not bought and sold, they nevertheless are valued highly by society. Yet because environmental goods and services are not exchanged in markets, measures of this wealth are missing from conventional economic statistics.

As a first step in rectifying this deficiency, Henry M. Peskin, assisted by Winston Harrington, Alan J. Krupnick, and David R. Yardas, has identified and documented the available data and the valuation methods needed to develop a consistent set of national environmental wealth accounts at the county level of detail. Their report identifies and describes more than 100 national and state data files and includes information on the characteristics of parks, wilderness areas, forests, and similar environmental assets that generate both recreational and aesthetic services. In addition, the team surveyed and evaluated some 200 technical papers on benefit estimation in terms of their potential for generating information that would permit attaching dollar values to those assets.

Peskin and his colleagues discuss in detail the problems of integrating the various data bases and valuation methods to generate a single data base consistent in its scope and definitions and with variables that can be measured in both physical and dollar units. The report was supported financially by the National Science Foundation.

Benefits of pollution control

Few Americans still equate belching smokestacks with progress, even in a time of economic recession. To the contrary, air pollution is everywhere reviled.

But to favor "clean" air is imprecise at best. If zero levels of air pollution are unattainable—and they are—what levels are acceptable in terms of human health, materials damage, and enjoyment of the outdoors? Or, put another way, what are the benefits of controlling air pollution at different levels and how much does it cost to obtain them?

Winston Harrington and Alan Krupnick have completed the initial phase of a project, sponsored by the U.S. Environmental Protection Agency, that compares the benefits and costs of alternative ambient air quality standards for nitrogen dioxide (NO_2). They began by surveying existing studies of NO_2's effects, especially on human health and on materials, to find results that would support construction of "dose–response" functions, that is, quantitative relationships between ambient NO_2 levels and human health. Only one such work could be found: a study of respiratory illness among school children in Chattanooga, Tennessee. However, this was one of several epidemiological studies, known collectively as the CHESS (Community Health and Environmental Surveillance System) program, which have been severely criticized for a variety of methodological problems. While these flaws effectively preclude the use of the Chattanooga study in benefit–cost analysis, the data may be of value. Therefore, the EPA has agreed to sponsor RFF to take a second look at the original data collected in Chattanooga to determine if a suitable dose-response function can be constructed.

Another extension of RFF's work for the EPA on air pollution control benefit estimation involves the effect of ozone on agricultural crop yields and the resulting welfare effects. This project, under the joint direction

The quality of the environment division is concerned with the management of air, water, and land pollution, and the conservation of natural and environmental resources. Special attention is given to the environmental consequences of energy development and use and to how public decisions affecting the environment are made.

of Raymond J. Kopp and William J. Vaughan, is exploring two alternative routes to this goal—an econometric simulation model of agriculture developed by Robert Taylor of Montana State University in cooperation with other agricultural economists, and construction of synthetic crop supply curves from model farm cost data.

Major environmental episodes

In the last ten years public attention has been gripped by chilling headlines about toxic substances loose in the environment: polybrominated biphenols in Michigan, Kepone in Virginia, and the Love Canal in New York, to name perhaps the most notorious. In each of these and similar incidents, accidental or mischievous dispersal into the environment of otherwise useful chemical substances caused long-term threats to human health, or persistent contamination of watercourses that once hosted recreational and commercial fisheries, or both.

These incidents inspired passage of a series of laws—the Safe Drinking Water Act, the Toxic Substances Control Act, and the Resource Conservation and Recovery Act—that prohibit or constrain such activities as the marketing of a new chemical, the siting of an unlined landfill, and the release of by-products into a watercourse. Such restrictions always impose costs, and the question of what those costs buy—in reduced damages from toxic-substances incidents—now is central to the redesign of environmental protection policies.

Monetary estimates of the value of environmental and health damages prevented are needed to answer the benefits question in terms commensurable with estimates of cost. Two years ago, the U.S. Environmental Protection Agency entered into a Cooperative Agreement with RFF aimed at clarifying and testing methods for estimating such damages, and since then Mark F. Sharefkin, Mordechai Shechter, and Vicki Aaronson have studied three toxic-substances incidents that attracted national attention: Kepone pollution of the James River in Virginia; contamination of the Atlantic City, New Jersey, water supply aquifer by Price's landfill; and the fire in the Chemical Control dump site in Elizabeth, New Jersey.

Primary data on each incident were assembled and a range of damage estimates made in each case, allowing for uncertainty about the natural systems involved and the human dose-response functions. The sensitivity of these ranges and of best point damage estimates to particular features of each incident also was examined. Thus, for example, in the Price's landfill episode, the fortuitous location of private domestic wells led to early detection of the plume of toxics in the aquifer and made actions to reduce damages possible (the shutting down of city wells in the plume). Chance always plays a part in such situations, but the important point is that substantially more damaging incidents were as likely as those that actually occurred. Therefore, any attempt to estimate the expected benefits of actions aimed at avoiding such incidents must be based on efforts that go beyond observed damages. The researchers conclude that in the context of these three case studies, a narrow focus on realized damages would result in a downward bias in benefit estimates. This should be kept in mind by those involved in future attempts to value the benefits of policies aimed at preventing toxic-substance incidents.

A second implication specific to the three cases examined may, in fact, be more general. In each of the three, a striking asymmetry exists between the costs of cleanup and the costs of prevention. For example, because kepone is remarkably persistent and nondegradable, cleansing the James River would require extensive dredging at a cost in the billions of dollars, while the annual costs of clean operation of the plant that released kepone into the river might have been less than $100,000.

A report on the project has been submitted to the EPA.

Nontechnical book on benefit estimation

Estimating the benefits of policies intended to control pollution probably is the most difficult task facing environmental economists. All of the factors that militate against pure market solutions for pollution problems also imply that the benefits of nonmarket solutions can be found only through technically difficult exercises, usually involving data collected for quite different purposes and unsuitable to the task. Usually this means that reports of benefits work are all but impenetrable to nonspecialists.

Some years ago the EPA attempted to fill the information gap by sponsoring a project leading to a nontechnical book describing research it had supported in estimating benefits from environmental improvement. That work has been carried out at RFF, and at the University of Wyoming, the University of New Mexico, and the University of Chicago. Originally, the book, being written by RFF's Allen V. Kneese, was designed to include only air quality benefits research, but during 1982 it was broadened to include water quality as well.

The major topics to be treated will be air and water quality and human health; the relationships between air quality and agricultural damages; damages specifically associated with urban air pollution; and, finally, aesthetic, recreational, and intrinsic benefits from improving air and water quality.

Forestlands and multiple-use management

The national forests of the United States must, by law, be managed to provide for multiple uses. In addition to timber harvests, they must provide wildlife, recreation, watershed, rangeland, and wilderness values. Some of the uses inevitably conflict. And the task is made even more complex by the dynamics of the forest ecosystem: the ability to control the character of the forest is limited by the slow natural growth of the trees.

Michael D. Bowes and John V. Krutilla have completed a paper—"Multiple Use Management of Public Timberlands"—that provides an economic synthesis and a generalization of existing dynamic models of multiple-use management and offers a number of simplified examples to illustrate the major conclusions. Among the issues touched on are several with policy significance, including the effect of multiple-use considerations on the level and stability of timber harvest flow; the likelihood of old-growth set-asides in an optimal solution; potential errors introduced by a budget process focused on single outputs when production is inherently joint; and the potential error from planning on too small a unit area, which may neglect ecological and visual links to adjacent lands. In contrast to the simpler existing models based on single timber stands, Bowes and Krutilla focus on the diversity of conditions across a set of adjacent stands. This provides a natural link to the demands for the recreational and amenity services that may depend in a complex manner on the pattern of vegetation across a wide area of the forest.

Forestlands and water resources

The National Forest System comprises a collection of different types of wildlands. Indeed, the legislation originally setting up the forest reserves in 1891 authorized the president to reserve public lands, ". . . wholly or in part covered with timber or undergrowth, whether of commercial value or not. . . ." The charge to the Executive Branch by the Congress in further legislation enacted in 1897 was "to improve and protect the forests" within the reservation boundaries and to attend to, among other things, "securing favorable conditions of water flows." Since early experiments in California a half-century ago, it has been observed that reducing vegetation under various conditions can augment flows in headwater streams. Removing trees reduces evapotranspiration and may increase significantly the portion of annual precipitation reaching streams. In some geographic regions having particular forest, precipitation, and demand characteristics, it is conceivable that land management intending to augment water flows and coincidentally improve the condition of timber stands can be justified by the returns measured in the jointly produced outputs.

John Krutilla has begun a review of the conditions under which such multiple-use management, taking into account the value of augmented stream flows as well as timber, would justify a land management program as opposed to general custodial management. His review will concentrate on specific areas of greatest promise.

Krutilla's and Bowes's work on multiple uses of forest lands is being conducted as part of RFF's Forest Economics and Policy Program, which is based in the Renewable Resources Division. The Program is supported in part by major grants from the Weyerhaeuser Company Foundation and the U.S. Forest Service.

PRODUCED ASSETS

The last ten years have seen a growing number of public policy issues arising from the industrial sectors of the national economy. The Reagan administration's emphasis on "supply side" policy programs reflects this trend. Concerns about dependence on foreign supplies of energy and critical minerals, the slowed rate of productivity growth, dangers emanating from industrial pollutants and toxic substances, the aging nature of capital stocks, and the many forms of governmental regulation provide only a partial list of other industrial policy problems confronting decision makers. Informed decisions on these issues require a comprehensive and thorough understanding of production activity and industrial organization at a far greater level of sophistication than previously has been attained.

Providing that understanding is the major goal of the division's program on produced assets.

Modeling the supply side

Under a three-year funding arrangement with the Electric Power Research Institute, RFF's Michael Hazilla and Raymond Kopp, with V. Kerry Smith of the University of North Carolina, have constructed a sectoral econometric model of the supply side of the U.S. economy. Thirty-four supply sectors are represented in the model, including agriculture, four resource extraction sectors construction, twenty-one manufacturing sectors, five service sectors, and two public utilities (electricity and natural gas). The model is designed to examine the impact of a large class of phenomena on sectoral demands for factors of production. For each sector, the demands for several types of capital and labor, thirteen types of energy, thirty-four nonenergy intermediate inputs, and twenty-six strategic materials may be investigated. Each sectoral model incorporates factor substitution possibilities and the impact of technological innovation and diffusion.

In its first application, the model was used to address the issue of sectoral energy substitution. Specifically, what prospects exist for substituting other factors of production for energy inputs as energy becomes relatively more expensive? This work has produced three useful insights. First, substitution possibilities vary dramatically across productive sectors of the U.S. economy, suggesting that previous research, which focused on the aggregate manufacturing level, can be misleading. Second, the association between energy inputs and capital assets is not uniform across sectors. Indeed, energy and capital are substitutes in half the sectors and complements in the others. Finally, the model reveals strong substitution possibilities between electricity and natural gas in almost all sectors employing these inputs.

A lengthy report detailing the model and the quantitative evidence behind these general conclusions was submitted to EPRI in September 1982.

ENVIRONMENTAL POLICY

Monitoring

As part of a larger project on alternatives to direct regulation in pollution control, funded by the Alfred P. Sloan Foundation, Clifford S. Russell and several colleagues are examining practices and problems in monitoring point sources of pollution discharge.

This work was begun for two related reasons. First, in the literature on effluent charges and marketable permits to pollute, analysts often compare policy alternatives in terms of the ease or difficulty of monitoring and enforcing them, but these comparisons seem in general to be based on naive and misleading ideas about the problems of monitoring. Second, and more fundamentally, while monitoring and enforcement are central to actually achieving society's stated goals for environmental quality, the environmental policy literature contains no comprehensive and careful analysis of these problems, which include the complications raised by inevitable imprecision in monitoring instruments, by the necessity to sample discontinuously, by unavoidable variation in the performance of the production and treatment processes that give rise to actual discharge levels, and by legal barriers to gaining entry to monitor private sources.

The aim of the research is to fill the observed gap in the literature and thus to provide a firmer basis for comparing alternative policies as well as alternative monitoring proposals themselves. To these ends, four major threads are being pursued. The first is a study of state environmental agencies to find out what practices now are followed, such as the importance attached to self-monitoring by sources, the frequency of agency auditing or monitoring visits to individual sources, and the ways in which compliance and noncompliance are defined. This will provide a baseline against which to compare alternative possibilities. Russell and Julia C. Allen are cooperating on this survey.

The second thread is an inventory and assessment of currently available monitoring technology for point sources of air and water pollution. The aim here is to provide a general summary of available instrument characteristics, including cost, precision, ability to measure continuously, and ability to measure remotely, for a range of individual pollutants of major interest. This work also is being done by Russell and Allen.

Third is the statistics of monitoring. Because of source variability, discontinuous monitoring, and instrument error, the identification of violations of discharge standards (or the measurement of actual discharges for emission charge billing) is not the simple matter usually assumed. Indeed, even the question of how best to *define* a discharge standard can be debated once the fundamental uncertainties are recognized. One intriguing question is whether optimal monitoring programs can be specified in practical situations where, for example, knowledge is lacking of the damages attributable to units of discharge and where sources have incentives to attempt to exceed permit terms in order to save money. William Vaughan has taken the lead in this phase of the work.

The final thread to be followed is the legal status of important monitoring isues, two of which are worth specific mention. First is the enforcement agency's rights of access for monitoring. If, for example, prior notice—even a warrant—is required to make a monitoring visit, then sources have at least the option of adjusting discharges in advance of such visits. Second is the rule of evidence that applies to proving a violation of a discharge standard (as embodied in a permit), using monitoring data with all the imperfections just described. Susan Bishop, a law student at the University of Virginia, undertook the research on these issues during a summer visit at RFF.

Pollution markets

Much of the U.S. Environmental Protection Agency's current effort at regulatory reform has been directed at using economic incentives. In particular, the EPA is exploring ways of making permits to pollute marketable. However, in spite of the potential cost savings of this approach, firms appear reluctant to take advantage of it. Alan Krupnick, with the EPA's John Palmisano, is evaluating the reasons for the slow growth of markets in pollution. They will identify alternative policies available to the states and the EPA that can promote the growth of permit markets.

Development and environment

Over the past thirty-five years, tens of billions of dollars have been spent on development projects in the Third World. By comparison, only minute amounts were spent to evaluate and control damages caused by those projects to the environment, to the natural resource base, and to life-support systems. Yet scientists in both developing and industrial countries alike point out that these damages may be enormous—not only in some distant future, easily ignored in the rush to industrialize, but even today with incomes still low and life expectancies still short. Such immediate threats include increased incidence of waterborne parasitic diseases caused by irrigation and hydroelectric projects; the loss of soil productivity caused by overgrazing, deforestation, and poor agricultural management practices; and urban air pollution from autos, industry, and home cooking fires, so severe that it can cause acute health damage.

In the longer run, these countries face a variety of damages resulting from current forestry and land management practices—loss of topsoil and nutrients, stream and reservoir siltation, and even climate change. Further, the continuing application of large quantities of persistent toxic pesticides and herbicides ultimately may threaten animal and human populations in many countries.

Some efforts—for example, at the World Bank and the U.S. Agency for International Development—have been made to come to grips with these threats in the process of making grants and loans. Moreover, the developing countries have begun to recognize the importance of environmental protection for sustained economic growth. Nonetheless, developing nations and the international lending agencies face a practical obstacle in bringing environmental awareness to bear on investment projects and programs. These institutions are long in macroeconomists—the traditional practitioners of development planning—and in engineers suited to the projects being contemplated; and they are beginning to develop expertise in environmental sciences. But they generally lack a sound basis for connecting these bodies of knowledge. The macroeconomists see the scientists as unrealistic lobbyists for unaffordable standards, while the scientists despair of fitting their concerns into a framework dominated by money values. This disparity of outlook is a classic quandary of environmental policy making, but for cultural and economic reasons it seems especially hard to solve in developing nations.

Acting on the belief that research and technical assistance—based on RFF's traditional strengths in applied microeconomics and environmental sciences and engineering—can make a large contribution to bridging this gap, the division is developing a program on environmental development. Two major components are likely:

- Developing new knowledge and methods for incorporating environmental considerations in macroeconomic forecasting and accounting procedures, and in development planning more generally

- Providing assistance to international development agencies and individual developing countries.

The substantive aim is to improve the ability of the development planning process to quantify the costs, in terms of capital investment requirements, skilled labor time, energy, or other accounting units, of efforts to make development programs and projects less environmentally damaging. Further, the program will begin the difficult task of measuring the benefits of those changes. This could be done, for example, by helping to predict reductions in the incidence of disease or lost working time caused by environmental investment affecting public health; by predicting the outputs of sustained yield programs designed to replace unregulated agriculture, forestry, and fishing; and by modifying national accounts to reflect damages to and uses of environmental and natural resources.

Primary responsibility for this activity has been taken by Walter O. Spofford, Jr., with the assistance of Blair T. Bower, Allen Kneese, Henry Peskin, and Clifford Russell.

Managing Asian water resources

A reconnaissance study of water resources management in Asia was carried out from May to September 1982 under the sponsorship of the Environment and Policy Institute of the East-West Center, with the cooperation of the University of Hawaii Water Resources Research Center and Resources for the Future. The basic rationale for the study was that increasing demands in Asia for food, energy, and domestic water will require considerably more efficient and effective water resources management than has been practiced in the past. The objectives of the reconnaissance were to ascertain the present status of water resources management in various countries and to develop a framework for analysis of water resources management. At a second stage, the framework will be applied in detail to a number of Asian countries, toward the goal of providing information they can use in improving their water resources management.

The study culminated in a mid-September workshop held at the East-West Center in Honolulu, in which invited experts on Asian water resources management interacted with the staff members who had worked on the study. Blair Bower helped to formulate the study and worked on it throughout the study period, and Emery N. Castle participated in the workshop.

Three-volume handbook

Allen Kneese has begun the task of editing, with James Sweeney of Stanford University, the *Handbook of Natural Resources and Energy Economics*. The handbook will consist of three volumes, one of them dealing with the environment, one with renewable resources, and the third treating depletable resources. These volumes will be part of a larger series of *Handbooks in Economics* published by the North Holland Press under the general editorship of Stanford's Kenneth J. Arrow and Michael D. Intriligator of the University of California, Los Angeles. The volumes on resources and energy are scheduled to appear in 1984.

RENEWABLE RESOURCES

The Renewable Resources Division is home for RFF's Food and Agricultural Policy and Forest Economics and Policy Programs. In addition to studies carried on within these programs, the division launched or completed major projects concerning soil erosion, water resources, the public lands, and possible human influences on global climate, and organized three workshops dealing with one or another of these subjects.

FOOD AND AGRICULTURE

Assessing productivity

U.S. food and agricultural productivity has grown steadily and dramatically throughout much of this century. In recent years, however, widespread concern has emerged about whether productivity growth may slow in the near future, or even approach a plateau. Are current agricultural surpluses destined to disappear in a few years, possibly to be replaced by chronic shortages? What makes for a productive U.S. agriculture and what policies are most conducive to keeping it as productive as possible?

The Food and Agricultural Policy Program, directed by Kenneth R. Farrell, is planning a comprehensive assessment of productivity in the food and agricultural sector. The project has three major objectives:

- To empirically isolate and measure the principal sources of change in agricultural productivity since World War II
- To assess the potential productivity impacts of alternative future technological, resource, economic, institutional, and public policy scenarios related to the U.S. food and fiber sector
- To assess the policy implications of the foregoing research, including policy options to enhance future productivity growth.

Several interdisciplinary advisory panels will be established, each consisting of roughly a half-dozen nationally recognized scientists, educators, and leaders from the public and private sectors. The results of the project will include a series of technical and popular reports designed for research leaders, public policy officials, and private decision makers.

Global food needs

Two major new projects were initiated late in the year in the Food and Agricultural Policy Program. The first, "An Assessment of Global Food Needs to the Twenty-First Century: Policy Implications for the United States," builds on several major reports of recent years concerning long-term global prospects for population, food, and natural resources. The project includes a reexamination of the potential productive capacity of U.S. agriculture to meet future domestic and international food demand, with emphasis on the adequacy of U.S. natural resources, emerging production technologies, and the role of public policies in shaping the future use of resources and the supply of food. Kenneth Farrell and Trang T. Vo are the principal investigators. They will be joined by a senior analyst to be employed in 1983.

Analyzing rural poverty

The second project, directed by Farrell and Irving Hoch, is examining the relationships between natural resource endowments, natural resource and selected other public policies, and the distribution of income and wealth and the incidence of poverty in rural areas. A major objective is to develop improved measures of poverty in rural areas. "Improved" in this case means not only more accurate, but also more inclusive. Accordingly, measures will be developed that go beyond dollar income to incorporate estimates of income-in-kind, including public assistance, and cost of living differentials within and between metropolitan and nonmetropolitan areas. As a part of the project, a set of papers will be commissioned for a mid-1983 workshop involving leading researchers and policy analysts. The workshop will explore key relationships and policy issues in rural development, poverty, and natural resources. The project will provide valuable information and insight for national, state, and local policy.

The Food and Agricultural Policy Program is funded in part by a grant from the Ford Foundation, which also has provided project funding for the work on rural poverty. The assessment of global food needs is being supported by the U.S. Department of Agriculture. In addition to its research agenda, the program offers dissertation fellowships through the generosity of the Jessie Smith Noyes Foundation. (Fellowship winners for the program year are listed on page 112, along with other RFF fellowships.)

Soil erosion

Two major studies involving agricultural land and soil erosion were published during 1982—*The Cropland Crisis: Myth or Reality?*, edited by Pierre R. Crosson, and *Resource and Environmental Effects of U.S. Agriculture*, by Crosson and Sterling Brubaker. (Descriptions of these volumes can be found on pages 57 and 58, respectively.)

The renewable resources division conducts research on integrated management of the land, including studies of food and agriculture, forestry, fresh water, and land use. It seeks knowledge of natural and human resources and an understanding of impacts of nature and people on both the resource base and human welfare.

C

Erosion seems to have arrived anew as a public issue. The popular press rediscovered it during the 1970s and, not surprisingly, treated it as a crisis: visions were raised of major portions of the Cornbelt floating down the Mississippi within a relatively few years. The reality is not nearly so dire, but it is serious, as Crosson and Brubaker identify the second volume mentioned above. Indeed, their survey of possible environmental damages attributable to increased acreage, irrigation, fertilizer, and pesticides led them to conclude that erosion stands out as the principal threat posed by an expanding U.S. agriculture to the natural resource base and to environmental quality. Present policies, they warn, are unlikely to hold erosion to acceptable levels.

Building on the results already obtained, Pierre Crosson is expanding his research on the effects of soil erosion and how to deal with them. In the first phase of this work, he is giving special attention to the effects of erosion on productivity of the soil and to management practices farmers may undertake, such as crop rotation and conservation tillage, to repair erosion damages by restoring soil organic matter. The role of new technology as a substitute for soil lost to erosion and the implications of this for traditional soil conservation policies also are being investigated.

Although damage to farms themselves comes first to mind when one thinks of soil erosion, much of the damage actually occurs off-site, including impaired water quality and siltation of waterways and reservoirs. Relatively little is known about the value of these damages, which impedes formulation of cost-effective policies for dealing with them. Crosson plans a reconnaissance survey of information about these damages as a first step toward their systematic study. An important part of the survey will deal with sediment delivery ratios—the numbers showing the relationships between gross erosion from farmers' fields and the amount of soil reaching water bodies.

Crosson's work on the several aspects of soil erosion and drainage is made possible by a grant from the Andrew W. Mellon Foundation.

FOREST ECONOMICS AND POLICY

Long-term timber supply

In the long-running debate about whether the United States is running out of forest resources, those lined up on the side of adequacy would seem to have an irrefutable argument: trees, after all, are renewable.

Yet one of the more intractable problems in forest economics is the question of the long-run supply of forest resources. This is because forest resources, for the short and intermediate terms, resemble nonrenewable resources in that they are relatively fixed and their use—like mining—results in the depletion of a fixed stock. A central economic question of the theory of mining is the optimal rate at which the resource is used.

Obviously, however, unlike hardrock minerals, forests do renew themselves, albeit slowly. A forest generally will regenerate itself naturally, if allowed to, but the natural forest's rate of regeneration can be accelerated by human intervention. For example, a variety of investment and management activities can enhance the rate of growth and quality of the resource and, by controlling the species and location, society can choose biologically superior species and sites.

The mining model governs the short run: supply depends largely on the rate at which the existing stock is drawn down. But in the long run, the stock is a variable in that it depends on the rate at which the stock is decreased *and* on the rates of reforestation and afforestation. In this context, short-term supply decisions affect both the size of the existing stock and expectations about the rate at which that stock will change through time.

Roger A. Sedjo and consultant Kenneth Lyon of Utah State University, assisted by Catherine Tunis, are investigating the long-term supply of timber resources. They have developed an optimal control theory model that permits the estimation and projection of economic rates of harvest from existing forests, including old growth, natural secondary growth, and man-made. The analysis examines questions of the optimal rotation period, silvicultural input levels, and land area in forest, as well as questions of the optimal drawdown of old growth. In a test of its efficacy, the model is being applied to two prototype forests—one in Sweden and one in the Pacific Northwest of the United States.

Global deforestation

According to conventional wisdom, many of the world's forests are under a several-pronged attack that threatens their long-term integrity and even their existence. *Global Future: Time to Act*, a report to the president of the United States prepared by the Council on Environmental Quality and the Department of State, represents a widely held view when it states that the world's forests, particularly the tropical forests, "are disappearing at alarming rates as growing numbers of people seek land to cultivate, wood to burn, and raw materials for industry."

How accurate is the common wisdom? Perhaps surprisingly, it is difficult to say: solid data about global and site-specific rates of deforestation are scanty and occasionally in conflict. Some forests under some conditions surely are being severely reduced, and this is creating a host of social and environmental problems. But the data that are available do not support an assertion that the world is running out of forests, or even that the tropical forests are being dangerously denuded.

Is deforestation necessarily an unmitigated bad? After all, some net reduction in global forests may be required to meet the full range of social, environmental, and developmental goals. If existing rates of deforestation are considered alarming, what rates would be considered acceptable?

Roger Sedjo and Marion Clawson, assisted by Catherine Tunis, are conducting a broad examination of the many questions attending global deforestation. Special attention is being given to determining just how pervasive deforestation is, and to the complex and interconnected economic, environmental, and social problems that both cause deforestation and result from it. Finally, the research team will assess what remedial actions may be appropriate and effective for reducing or reversing deforestation when and where it is judged to be a serious threat.

The Forest Economics and Policy Program maintains resident and dissertation fellowships in addition to its research activities. (These are reported with other RFF fellowships, on page 111.) The program, which includes the work of John V. Krutilla and Michael D. Bowes (see pages 35-36) as well as that covered here, is directed by Roger Sedjo and funded in large part by major grants from the Weyerhaeuser Company Foundation and the U.S. Forest Service.

WATER RESOURCES

Like soil erosion, water has become a recent news media sensation. Perhaps in part because the energy "crisis" has been replaced by an oil glut, however temporarily, and certainly because an adequate supply of fresh water to satisfy all possible demands is by no means assured, the major news weeklies and other media are trumpeting alleged looming water scarcity as the crisis of the decade. Whatever credence one gives such alarmist reports, water is widely viewed as being at the forefront of the nation's resource concerns of the 1980s.

Assessing the nation's water supply

Despite the popular interest in water and the efforts of several major government water studies, many questions remain about the severity of U.S. water problems and their underlying causes. The national water assessments fall short principally because they attempt to assess water supply adequacy in the absence of any notion of demand or value, and because they fail to consider the institutions that allocate water among alternative uses. For example, the data assembled by the most recent national water assessment can help to identify locations where water should be viewed as a scarce resource, but they provide little insight about how critical the problem is and even less about alternative solutions.

Kenneth D. Frederick is directing a two-year project designed to improve understanding of the nature of the nation's water problems and alternative ways to deal with them. The project has four interrelated parts—a review of prior efforts to examine the nation's water problems, an assessment of the value of water in the various water resources subregions, an examination of the institutions affecting the allocation of water resources within selected water supply problem areas, and an identification of the additional steps required to produce a more policy-relevant, comprehensive assessment of the nation's waters.

Frederick's study of irrigation water availabilities in the western United States—a use that consumes nearly 90 percent of all water in the region—was published during the year as an RFF research paper (*Water for Western Agriculture* is described on page 60).

FEDERAL LANDS

The people of the United States like to think of the U.S. economy as solidly "capitalist" or, leaning slightly leftward, as "mixed." The institution of private property is all but sacred.

Yet roughly one-third of all land in the nation—including huge chunks of the western states—is owned and administered not by private individuals or corporations but by the federal government. The size and location of the federal holdings generate political backlash, such as the Sagebrush Rebellion, present management challenges, and raise tax and equity questions. Especially as the public lands become more valuable, some people in and out of government are asking a very fundamental question indeed, Would the country be better off if much of the public lands were sold to private buyers?

Federal lands policy issues

Marion Clawson is analyzing policy issues concerning the federal lands administered by the U.S. Forest Service and the Interior Department's Bureau of Land Management. In a book-length study, Clawson reviews the history of these lands in some detail, especially as that history affects present policy issues, and he traces current land uses and recent trends in use. He demonstrates that changing times have brought both new problems and new opportunities for these lands. Of particular interest is the great increase in their value as petroleum products, coal, and timber have become more valuable.

Clawson presents the arguments for retaining these lands in federal ownership as he believes the advocates of that position would do. Similarly, he provides an advocate's arguments for wholesale disposal of federal lands to private ownership. Of course, a number of alternatives exist between complete retention and complete disposal, and Clawson explores these in detail. One novel idea is "pullback," whereby rival claimants could obtain at least part of the area applied for by any applicant. The study also considers the special problems of intermingled land ownership, and of public participation in federal land planning.

CLIMATE

The division's principal work on climate issues culminated during the year in the publication of an RFF research paper, *The Economics of Managing Chlorofluorocarbons: Stratospheric Ozone and Climate Issues* (see page 59, for a brief description). The volume grew out of a major international conference convened to consider the proper response to the ozone-depleting and climate-changing effects of the chlorofluorocarbons, a class of chemicals used in spray cans, plastics, and refrigerants. Both the conference and the research paper were conducted in close cooperation with the U.S. Environmental Protection Agency and the University of Maryland, with Irving Hoch playing the principal role for RFF.

As a follow-up effort, also supported by the EPA and the University of Maryland, Hoch undertook additional studies on the relations of consumption to climate. In addition to extending his earlier work by relating energy use and ownership of air conditioners to climate, Hoch established significant relationships between spending on a number of consumption goods, including food and housing, and climate variables. A report was submitted to the sponsoring agencies.

Hoch also carried out a literature review for the U.S. Urban Mass Transportation Administration on the relations between land use, energy consumption, and transportation, and submitted a report based on that review.

WORKSHOPS

Housing: Briefing Capitol Hill

"The Housing Recession and Its Effects on the Forest Products Industry" was the focus of a breakfast round table held in May for staff members of relevant congressional committees. The meeting, held at the National Housing Center in Washington, D.C., was sponsored by the Forest Economics and Policy Program (FEPP).

The discussion was organized by FEPP Director Roger A. Sedjo and featured informal presentations by Sedjo and Marion Clawson of RFF and Anthony Downs, a senior fellow at the Brookings Institution.

Erosion and productivity

Properly managed, soils can produce crops year after year for thousands of years. On the other hand, erosion can so strip the topsoil from cropland that it becomes economically useless for crop production. But how much erosion is too much? How do soil losses affect productivity? Perhaps surprisingly, data are incomplete and cause-and-effect relationships unclear about precisely how erosion influences productivity.

As part of ongoing work on these questions, Pierre Crosson prepared a report, "Productivity Effects of Cropland Erosion in the United States," and exposed it to critical analysis from soil scientists and agricultural economists at a one-day workshop held at RFF in June. Crosson is revising his report in response to the comments and criticisms made at the workshop.

Rethinking the federal lands

The Reagan administration's proposal to sell some of the federal lands to private owners has generated a good deal of heat. Buttressed by the views of potential owners and by arguments of some economists that private land ownership inherently is more efficient and contributes more to social welfare than public ownership and administration, the administration's plans are provoking outraged charges by conservationist organizations and others of a sellout of the nation's natural endowment.

Concluding that such an important question should not be resolved primarily by charge and countercharge in the popular press, the division organized a national workshop designed to provide a more scholarly discussion of the issues. Held in September in Portland, Oregon, the workshop's theme was "Rethinking the Federal Lands," and it focused on various existing, proposed, and possible tenure arrangements for these lands.

Organized by Sterling Brubaker, with the assistance of Anthony T. Stout, the two-day workshop sought a wide range of views both in the formal papers and discussions and in the audience invited to participate. The arguments both for retaining and disposing of federal lands were considered, as were several intermediate positions in which the government would retain title but yield many direct management functions. The program also featured reactions of principal interest groups to the range of policies. Results of the meeting will be considered for publication by RFF.

Authors and titles of papers presented at the workshop include:

Paul Gates, "The Federal Lands: Why We Kept Them"
Perry Hagenstein, "The Federal Lands Today: Uses and Limits"
Utah Senator Mike Mitchell, Luncheon Address
Joseph Sax, "'For Sale': A Sign of the Times on the Public Domain"
Gordon Tullock, "The National Domain and the National Debt"
Marion Clawson, "Alternatives Intermediate Between Full Retention and Full Disposal"
John Leshy, "Sharing Federal Multiple-Use Lands: Lessons from the Past and Speculations About the Future."

In addition, the following persons participated in the workshop as moderators or discussants: William T. Creson, Barney Dowdle, D. Michael Harvey, Carl H. Stoltenberg, Richard Stroup, Gordon Bjork, Charles F. Luce, Robert Nelson, F. L. C. Reed, Emery N. Castle, Ray M. Housley, Frank Edwards, Laird Noh, George Craig, Rowena Rogers, and Gaylord Nelson.

BOOKS IN BRIEF

The principal means of disseminating RFF's research findings is the printed page. For research results of significant substance and length, this means books and research papers, more than two hundred of which are now in print. As a matter of policy, RFF does not publish work which is unrelated to its research program.

Major studies generally are published as clothbound books if the results will make an important contribution to the field or to public understanding and are likely to have broad appeal, either at the time of publication or over the course of a few years. When they appear to have especially broad appeal, such as for course use, books also may be published in a paperback edition. Manuscripts destined for publication as books are professionally edited by RFF editors and typeset, and the result is promoted to potential purchasers as representing a comprehensive and cohesive piece of work consistent with past RFF standards.

Research papers provide an alternative form of publication in that they usually are reproduced directly from authors' typescript and published in paperback only. Among the reasons for publishing a manuscript as a research paper rather than as a book are that it presents work in progress that would be useful to a professional audience without further research; that it possesses a timeliness that might suffer by the usual review and editorial process; and that it appears to have a specialized readership.

Thus, the principal criterion that distinguishes a book from a research paper is breadth of appeal, which may stem either from a broad audience when the publication appears or from sustained demand over time, or both. Research papers generally will contain technical material that does not appeal to a large audience or research results in which there is not likely to be broad or long-run interest, while the reverse is true of books. Neither "importance," however defined, nor scholarly quality is a distinguishing criterion between the two types of publication. With rare exceptions, both are published by Resources for the Future and distributed for RFF by The Johns Hopkins University Press.

Twelve volumes were published from October 1, 1981, through September 30, 1982. The section that follows describes each of the five books and seven research papers, arranged in alphabetical order by author. Bibliographic information on these and other publications is listed beginning on page 70.

Analyzing Natural Systems—Analysis for Regional Residuals–Environmental Quality Management

Daniel J. Basta and Blair T. Bower, editors

During the past two decades the development and use of models to analyze natural systems has greatly intensified, primarily in response to the mandated planning requirements of the National Environmental Policy Act, the Clean Air and Water Acts, and related state and local legislation.

Choosing natural systems models

Thus, current laws require the analysis of such natural systems as surface water bodies, groundwater aquifers, and atmospheric systems in order to evaluate the impact of human activities on their ambient quality and to assess various strategies for achieving and maintaining an acceptable level of quality. Models enjoy wide use because they offer analysts and policymakers a way to capture and represent many of the myriad interrelated components of natural systems. But which model is appropriate in a given context, and how do the separate parts relate one to another?

The contributors to this research paper provide an overall management framework—Residuals–Environmental Quality Management—that is based on pathbreaking research conducted over the past decade by RFF's Quality of the Environment Division. And they provide a practical guide to the selection of natural systems models in a regional management context. Specifically, the authors give detailed descriptive summaries of models appropriate for analyzing land runoff, receiving waters, and atmospheric systems, and furnish annotated references to these models.

The editors intend their compilation to be a user's handbook. Designed for those who must carry out analyses for environmental quality management decisions, the volume also will be helpful to faculty, students, and others who wish a detailed grounding in analyzing natural systems.

Daniel Basta is deputy director of the Office of Ocean Resources Coordination and Assessment of the National Oceanic and Atmospheric Administration. Blair Bower is consultant in residence in RFF's Quality of the Environment Division.

Deposit-Refund Systems—Theory and Applications to Environmental, Conservation, and Consumer Policy

Peter Bohm

"No deposit–no return" may represent efficiency and profits for container manufacturers and supermarkets, but throwaway cans and bottles consume more raw materials than do reusables and they contribute to roadside litter. Hence, the effort in several states—initially Oregon—to pass laws requiring refundable deposits on consumer containers.

Bohm cites bottle bills as being but one application of deposit-refund systems—economic incentives designed to encourage desirable behavior on the part of business and the public. Primarily theoretical, his book carries the reader from the foundations of the deposit-refund systems to some successful examples of their use.

Consumer-paid versus producer-paid deposits

In the use of government-initiated deposit-refund systems, the author distinguishes between and evaluates consumer-paid and producer-paid deposits and indicates how the latter could be used to provide performance incentives for government agencies. He also reviews the empirical evidence on the effectiveness of deposit-refund systems and describes two potential applications—encouraging maintenance of spare-parts stocks and controlling the fate of chlorofluorocarbons used in refrigeration units, a probable source of stratospheric ozone depletion.

Peter Bohm is professor of economics at the University of Stockholm.

U.S.–Japanese Agricultural Trade Relations

Emery N. Castle and Kenzo Hemmi, editors;
with Sally A. Skillings

In 1973 the United States embargoed the export of soybeans. This caused an uproar in Japan, which had counted on U.S. friendship to assure the supply of one of its most important foods. Although the shipment of soybeans to Japan resumed fairly quickly, the embargo temporarily soured the friendly relations between the two democracies. How did such an incident come about?

This book, prepared by a group of Japanese and American scholars, demonstrates for the first time how trade relations between the two countries are affected by their respective internal political situations and by the nature of their agricultural industries.

The book is unique in that it presents, in English, information and analysis of Japanese agriculture that heretofore was available only in Japanese. Moreover, scholars and policymakers in both countries now will have available for comparison data on each country's agricultural sector.

Necessity for U.S.–Japanese cooperation

The book could hardly be more timely. According to Castle and Hemmi, cooperation between Japan and the United States is essential if the year-to-year instability in international food markets is to be minimized and if the powerful wave of protectionism now sweeping the world is to be rolled back in favor of free trade.

Emery Castle is president and senior fellow at Resources for the Future. Kenzo Hemmi formerly was dean of the Faculty of Agriculture of the University of Tokyo. Sally Skillings is managing editor in RFF's Public Affairs Division.

The Cropland Crisis—Myth or Reality?

Pierre R. Crosson, editor

The controversy over the supply of agricultural land is not unlike the recurring debate over the availability of other natural resources—opinions are diverse and wide ranging, reflecting differences in perception and approach.

This volume, the product of an RFF conference on agricultural lands, defines the nature of the controversy, the factors affecting supply of cropland, and the ways in which growing demand could be met.

One of the reasons it is so difficult to reach a consensus on whether the United States is running out of farmland is that often the issue is not whether there is enough land to meet future demands for food and fiber, but whether the nation is losing the aesthetic amenities that farmland provides in the form of open spaces, pleasant vistas, and rural life-style. Amenity values and production values are not the same, and to use one to defend the other is to argue at cross-purposes.

Adequacy of agricultural land

The contributors to this volume find there is no simple answer to the question of adequacy. Technological advances, long-term demand for food and fiber, and the economic and environmental costs of production all interact to affect judgments about the adequacy of agricultural land.

What emerges from these papers is the critical role of technology in reducing pressure on the supply of farmland. It is a key and uncertain variable in any judgment of the adequacy of future cropland supply.

Pierre Crosson is a senior fellow in RFF's Renewable Resources Division.

Resource and Environmental Effects of U.S. Agriculture

Pierre R. Crosson and Sterling Brubaker

In recent years many have questioned the capacity of American agriculture to meet the demands placed on it. Expanding demand for exports, especially of grains, has increased the pressure on U.S. land resources at a time when the loss of farmland to urban development appears to have accelerated and concern about erosion and pesticide use have grown. How does one evaluate the future environmental effects of U.S. agriculture?

Pierre Crosson and Sterling Brubaker offer a framework and analysis of those effects in this research paper. They project future demand and examine the resources needed to meet such demand under various assumptions about technology and the growth of yields per acre. After translating careful estimates of the amount of land, irrigation, fertilizer, and pesticides needed into resulting environmental damages, Crosson and Brubaker conclude that the possibility of increases in erosion as production grows stands out as the principal threat. While there is great flexibility to meet increased demand, they say, present policies are unlikely to hold erosion to acceptable levels, especially if an additional 60 to 70 million acres are brought under crops by 2010, as present trends indicate is likely. Speculation about alternative policies that might be more effective concludes the report.

Spurring technology

Particularly in light of relatively slow technological advances in recent years, the authors suggest that both the economic and environmental costs of agriculture will rise unless countermeasures are taken. They see increased public investment in new high-yielding, low-erosion control efforts on the most severely affected regions as the best means of checking prospective cost increases.

Pierre Crosson is a senior fellow, and Sterling Brubaker is associate director and senior fellow in RFF's Renewable Resources Division.

The Economics of Managing Chlorofluorocarbons— Stratospheric Ozone and Climate Issues

John H. Cumberland, James R. Hibbs, and Irving Hoch, editors

The international contributors to this research paper address the challenge of protecting the earth's stratospheric ozone shield and its climate against possible irreversible damage from the growing use of chlorofluorocarbons (CFCs). A class of chemicals that have proved useful as spray-can propellants, solvents, and plastics, CFCs are of special importance in refrigeration and air conditioning.

Threats from above

However, CFC emissions in the lower part of the atmosphere contribute to the so-called greenhouse effect by absorbing emissions of infrared radiation from the earth's surface, thus contributing to a rise in temperature. And by allowing harmful ultraviolet radiation to reach the earth's surface, CFCs are thought to increase the likelihood of such negative consequences as human skin cancer, livestock disease, forest injury, and fishery losses.

The contributors address the problems of irreversible atmospheric damage from CFC emissions and of achieving equity and efficiency among generations that must bear the costs of protective measures. They cover as well questions of international environmental management and decision making where knowledge is incomplete.

In so doing, they present the first comprehensive discussion of the socioeconomic issues involved in the management of CFCs and develop concepts and methodologies that can be applied to many problems involving other global economic hazards.

John Cumberland is professor of economics and director of the Bureau of Business and Economic Research at the University of Maryland. James Hibbs is an economist with the U.S. Environmental Protection Agency. Irving Hoch is a senior fellow in RFF's Renewable Resources Division.

Water for Western Agriculture

Kenneth D. Frederick; with James C. Hanson

Who gets the water?

A principal concern for the 1980s—the adequacy of the nation's water resources—is especially critical in the West. There, a variety of users—farmers, industry, municipalities, the energy sector, and recreationists—compete for scarce supplies, which in many instances are nonrenewable.

Irrigation, which consumes nearly 90 percent of all western water, has been an important factor in the region's development and the nation's agricultural performance over recent decades. But the growth of irrigation was spurred by access to inexpensive water, and cheap water is becoming a thing of the past. Indeed, as the price of western water rises, irrigation is the single area most affected, for agriculture not only is by far the largest user of water in the region but also is the economically marginal user. That is, irrigators would be least able to compete for scarce supplies if water were allocated through a market mechanism.

Although most water is not now allocated through markets, and rights of present surface-water irrigators to future allocations of those waters seem secure, the rising cost of water almost certainly means that irrigation's future course will be determined by very different conditions than have prevailed during its rapid development and growth. This research paper examines in detail what factors are likely to affect the future of irrigation in the West, including the myriad laws and institutions governing use and transfer and technological and scientific advances—more efficient irrigation systems, new crop varieties that require less water, and improved knowledge of the relation between plant growth and water stress.

Kenneth Frederick is a senior fellow and director of RFF's Renewable Resources Division. James Hanson teaches at the University of Maryland's Institute for Applied Agriculture and The Johns Hopkins University School of Advanced International Studies.

Collective Action
Russell Hardin

Public choice, a recent but important subdiscipline in the field of political theory, seeks to understand how people and societies make decisions affecting their collective lives. Relying heavily on theoretical models of decision making, public choice postulates that people act in their individual interests in making collective decisions.

As it happens, however, reality does not mirror theory, and people often act contrary to what the principal public choice models suggest.

Public choice in the real world

In this book, Hardin looks beyond the models to find out why people choose to act together in situations that the models find quite hopeless. He uses three constructs of modern political economy—public goods, the Prisoner's Dilemma, and game theory—to test public choice theories against real-world examples of collective action. These include movements important in American society in the past few decades—civil rights, Vietnam, women's rights, and environmental concerns.

Russell Hardin is associate professor of political science at the University of Chicago.

High Energy Costs: Assessing the Burden

Hans H. Landsberg, editor

The continuing lifting of controls from the price of domestically produced oil and natural gas raises the cost of energy to all end users, but does so with differing impacts, depending on income, location, and employment. Accordingly, the issue of "equity" in sharing the burden of higher energy prices has been central to the debate over energy policy and has been one of its more divisive features.

The equity issues of energy costs

In view of this, Resources for the Future sponsored a joint conference with the Brookings Institution to examine the equity issues of energy costs. A short report summarizing the conference was published in October 1981 as *High Energy Costs: Uneven, Unfair, Unavoidable?* In this research paper, the conference papers are presented in full, along with the accompanying debate and discussion.

The Distribution of Household Energy Expenditures and the Impact of High Prices Harold Beebout, Gerald Peabody, and Pat Doyle
Energy Assistance Schemes: Review, Evaluation and Recommendations Alan L. Cohen and Kevin Hollenback
Burden Allocation and Electricity Utility Rate Structures: Issues and Options Robert F. Hemphill Jr. and Ronald L. Owens
The Political Economy of U.S. Energy and Equity Policy William Darity, Ronald Johnson and Edward Thompson
Energy and Real Income Distribution: The Urban Sector Kenneth A. Small
The Impacts of Rising Energy Prices in Rural Areas Paul W. Barkley
The Differential Effects of Rising Energy Prices on Regional Incomes and Employment William Miernyk
The Equity Issue in Europe and Japan Eberhard Meller
Panel addresses:
Energy and Poverty Thomas C. Schelling
Perspectives on Coping with Massive Price Shifts: Comments Herbert Stein
Informal Remarks Gar Alperovitz

Commentators include Larry Ruff, Mark N. Cooper, Randall D. Weiss, Marvin M. Smith, Charles A. Zielinski, Jan Acton, Ronald D. Brunner, Wayne Hoffman, Ellis Cose, Brady J. Deaton, Otto C. Doering III, Mary Procter, Edward R. Fried, and Anne P. Carter.

Hans Landsberg is a senior fellow in RFF's Center for Energy Policy Research.

U.S. Household Consumption, Income, and Demographic Changes, 1975–2025

Philip Musgrove; with the assistance of Adele Shapanka

A companion volume to Ridker's and Watson's *To Choose a Future: Resource and Environmental Consequences of Alternative Growth Paths*, this research paper complements RFF's previously published study. Using the same population assumptions and sectoral breakdown, Musgrove focuses on population effects by examining a set of scenarios assuming no growth in labor productivity, a set not used by Ridker and Watson, and another set assuming an annual productivity growth of less than 2 percent, which is used in the previous book.

Musgrove uses cross-sectional data to derive consumption functions by household categories and goes far beyond previous studies in his use of the 1972–73 Consumer Expenditure Survey of the Bureau of the Census and the Bureau of Labor Statistics to analyze consumption.

While its findings should not be construed as forecasts, this study does make a major contribution to the methodology and analysis of consumer expenditures and projections of consumption patterns. The results also suggest some interesting insights about the effect of the demographic composition on expenditure patterns that can be tested by further research.

Effect of demographic composition on expenditure patterns

Philip Musgrove is a health economist in the Division of Comprehensive Health Services of the Pan-American Health Organization. Adele Shapanka is a consultant with Consad Research.

Explorations in Natural Resource Economics

V. Kerry Smith and John V. Krutilla, editors

The papers in this volume reexamine the economics of natural resources from the viewpoint of three major issues.

First, has the traditional perception of mineral availability in natural resource economics been consistent with the geochemistry of their occurrence in nature?

The second is the failure of economic models to reflect the effect of economic activities on such nonmarket resources as air and water, and what this may mean for estimates of resource availability.

An information gap?

Finally, the authors look at the simplified neoclassical representation of physical transformations in the production process and ask if the role of natural resources is properly modeled. Underlying all of these concerns is the question of whether adequate institutional mechanisms exist to provide relevant information for prudent public natural resource policy choices.

This is a pathbreaking theoretical work with contributions by Morton I. Kamien, Nancy L. Schwartz, Geoffrey Heal, Partha Dasgupta, A. Myrick Freeman III, Lawrence J. Lau, Raymond J. Kopp, DeVerle P. Harris, Brian J. Skinner, Shantaganan Devarajan, and Anthony C. Fisher.

Kerry Smith is professor of economics at the University of North Carolina at Chapel Hill. John Krutilla is a senior fellow in RFF's Quality of the Environment Division.

Rural Energy Development in China

Robert P. Taylor

The author presents a detailed analysis of the development of energy resources for rural household consumption and agricultural production in the People's Republic of China. He pays particular attention to the development of decentralized energy systems, including small coal mines and hydroelectric plants, biogas digestors, and afforestation programs to supply fuelwood.

Lessons from the Chinese experience

Currently, many developing countries are facing serious difficulties in providing adequate fuels for cooking, heating, and agricultural uses in the rural sector. Since China has faced similar problems in the past, her experiences with both centralized and decentralized energy systems may prove valuable to other countries in their search for solutions.

Drawing on data from a wide variety of sources, Taylor presents the first comprehensive description of the Chinese experience in rural energy development. An annotated bibliography of both Chinese and non-Chinese sources is included for the reader's further study.

Robert Taylor is a consultant on energy and formerly was a visiting scholar in RFF's Center for Energy Policy Research.

PUBLIC AFFAIRS

Perhaps more so than at any time in the three decades since Resources for the Future was established, the American public is aware of the central role economic and social policies play in determining the quality of life. Controversial Reagan administration policies, the apparent lack of effective Democratic alternatives, and the economic recession all have sparked wide interest and heightened the need of private decision makers, office holders, and the public at large to understand more fully the actual and potential effects of public policies.

In such a climate, RFF's work is valuable to an ever-widening audience. Indeed, as Emery Castle makes clear at the outset of this report, RFF is actively engaged in providing unbiased information and dispassionate analysis not only to those who form and implement policy, but also to those who seek, for whatever reason, to understand that policy.

Publications

Books and research papers—the cornerstone of the RFF publications program—are professionally designed, edited, and published by RFF in cooperation with The Johns Hopkins University Press. The distinction between the two types of publication essentially is one of breadth of appeal. Books are intended to be of relatively broad immediate interest, or of enduring interest, or both. They are thoroughly edited, typeset, indexed, and published in cloth-cover editions, frequently accompanied by paperback editions when classroom use appears likely. The research paper series is designed specifically for book-length works that add significantly to the professional literature but are highly topical or written for a specialized audience. Research papers are published in paperback only and reproduced from authors' typescripts with varying degrees of editorial assistance.

As is typical, the year's list of titles ranges from highly theoretical works to the more applied and topical approach particularly useful for policymakers. The twelve books and research papers published during the 1982 program year bring to more than 200 the total number of RFF volumes currently in print. An annotated catalog of the total list is available on request.

The RFF reprint series provides free single-copy distribution of a selected number of the many contributions of the research staff to profes-

Central to the effectiveness of any research endeavor is communication of findings to educators, government leaders, corporate executives, and the interested public at large. Through its publications, the print and electronic media, and a variety of special events, RFF reaches a wide and multifaceted audience

sional journals. During the past year, more than 5,000 copies of reprints were provided to requestors.

Researchers frequently need to solicit comments from professional colleagues while work is in progress. They also may wish to release early results in a more timely fashion than is appropriate for formal publication. The discussion paper series is designed to meet both needs.

Books, research papers, reprints, and discussion papers published during the program year are listed at the end of this section.

Over the years, RFF has sought to bring to the informed and concerned reader who may not have specialized knowledge of the various research disciplines or of the policy process an understandable accounting of its work on natural resource issues. When it is feasible to do so, books are targeted to such an audience. In addition, the periodical, *Resources*, published four or more times a year by the public affairs staff, features brief, timely articles describing work in progress and analyzing national or world developments. While most issues of *Resources* cover a wide range of subjects, occasionally an issue is devoted to a single topic of special interest. The winter issue looks retrospectively at key influences on natural resource and environmental developments during the past year and offers a prospective view of the coming year.

Resources is sent free of charge to the more than 22,000 individuals, libraries, and institutions on the RFF mailing list. Any interested reader may request that his or her name be added to the list.

FOCUS radio

FOCUS, the weekly public affairs radio series, marked its seventh year of operation in 1982. Under RFF's leadership, the six organizations that formed the sponsoring consortium produced a full year of programming—fifty-two half-hour shows distributed by the Longhorn Radio Network (University of Texas) to more than 230 stations and offered via satellite to National Public Radio stations. Participating were the American Association for the Advancement of Science, the Brookings Institution, the Conservation Foundation, the Overseas Development Council, and the Woodrow Wilson International Center for Scholars at the Smithsonian Institution.

RFF programs produced during the program year included:

- *Focus on Environmental Regulation and the U.S. Economy*, with Henry M. Peskin and Winston Harrington of RFF and Barry P. Bosworth, senior fellow at the Brookings Institution.
- *Focus on High Energy Costs*, with RFF's Hans H. Landsberg and Joseph M. Dukert, energy consultant and writer.
- *Focus on Renewable Energy*, with Scott A. Noll of RFF and Mark Lyons, then program director and legal counsel at the Renewable Energy Institute and now a fellow in RFF's Center for Energy Policy Research.
- *Focus on Cropland*, with RFF's Emery N. Castle and Pierre R. Crosson.
- *Focus on U.S.–Japanese Agricultural Trade*, with Emery Castle and Fred H. Sanderson, guest scholar at the Brookings Institution.
- *Focus on Regional Conflict*, with Hans Landsberg and U.S. Senator Paul E. Tsongas (D.–Mass.).
- All six programs were moderated by Harry B. Ellis, senior economics correspondent of the *Christian Science Monitor* and regular panelist on the Public Broadcasting Service television show, "Washington Week in Review."

Exhibits

Professional society meetings provide the opportunity for RFF to bring its research to the attention of members of the scientific and scholarly community through exhibits of books, research papers, and other publications. For meetings in Washington and some key conferences elsewhere, RFF staffs the exhibit either independently or in cooperation with The Johns Hopkins University Press and the World Bank. For other meetings where only a limited number of RFF publications are to be sent, they are part of a combined book presentation. Similarly, RFF researchers, called upon frequently to speak at various meetings throughout the year, take with them sample copies of pertinent publications.

Briefings

Popular synthesis of research findings often requires a delineation of ideas beyond the formal presentation in books or reports. Accordingly, RFF sets up periodic briefings through which researchers can respond to questions about their work from reporters, other researchers, congressional staff members, and representatives of special interest groups. Frequently timed to coincide with the publication of new research findings, the briefings also may focus on legislative and regulatory developments that fall within the fields of researchers' expertise.

BOOKS

RFF books published during the 1982 program year (October 1, 1981–September 30, 1982):

Basta, Daniel J., and Blair T. Bower, editors. *Analyzing Natural Systems—Analysis for Regional Residuals–Environmental Quality Management.* RFF, 1982. 564 pp. $30.00. Research Paper. 0–8018–2820–1.

Bohm, Peter. *Deposit-Refund Systems: Theory and Applications to Environmental, Conservation, and Consumer Policy.* RFF, 1981. 192 pp. $22.00. 0–8018–2706–X.

Castle, Emery N., and Kenzo Hemmi; with Sally A. Skillings. *U.S.–Japanese Agricultural Trade Relations.* RFF, 1982. Cloth, $35.00, 0–8018–2815–5. Paper, $14.95, 0–8018–2814–7.

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190. *Adjustment to Higher Oil Prices in Oil-Importing Developing Countries,* by Joy Dunkerley, with Andrew Steinfeld. 1982.

191. *Wilderness as One of Many Land Uses,* by Marion Clawson. 1982.

192. *Effects of an Export Embargo on Related Goods: Logs and Lumber,* by A. Clark Wiseman and Roger A. Sedjo. 1982.

193. *The Endangered Species Act and the Search for Balance,* by Winston Harrington. 1982.

194. *Changing Growth Patterns and World Order,* by Lincoln Gordon. 1982.

195. *Factors in the Development of a Major U.S. Synthetic Fuels Industry,* by Harry Perry and Hans H. Landsberg. 1982.

196. *Controlled Trading of Pollution Permits*, by Clifford S. Russell. 1982.

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D–73M. Energy in Developing Countries Series. Reforestation and Community Development in the Sudan. Turi Hammer, September 1982.

D–80. The Distribution of Recreational Benefits from Improved Water Quality: A Micro Simulation. Winston Harrington, November 1981.

D–81. Applications of the RFF Environmental Data Inventory. Leonard P. Gianessi and Henry M. Peskin, December 1981.

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D–82F. Energy and National Security Series. Oil Supply Disruptions and the Optimal Tariff/Quota in a Dynamic Stochastic Equilibrium Model. Zvi Eckstein and Martin S. Eichenbaum, June 1982.

D–82G. Energy and National Security Series. Emergency Demand Restraint Measures: A Descriptive Survey. Michael J. Coda, July 1982.

D–82H. Energy and National Security Series. The Benefits of International Energy Cooperation: A Theoretical Perspective. Michael A. Toman, September 1982.

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D–85. Rationality and Irrationality in the Public's Perception of Nuclear Power. Robert Cameron Mitchell, January 1982.

D–86. Ordinal and Dummy Explanatory Variables: An Errors in Variables Approach. Richard T. Carson, Jr., January 1982.

D–87. An Economist's Reflections on Man's Relation to Nature. John V. Krutilla, January 1982.

D–88. Selected Issues in Public Land Policy. John V. Krutilla, January 1982.

D–89. Formal Versus De Facto Systems of Multiple Use Planning in the Bureau of Land Management: Integrating Comprehensive and Focused Approaches. Christopher K. Leman, January 1982.

D–90. A Dynamic Analysis of Cropland Erosion Control Policy. James S. Shortle and John A. Miranowski, February 1982.

D–91. Impact of Erosion Control Policies on Wildlife Habitat on Private Lands. John A. Miranowski and Ruth Larson Bender, March 1982.

D–92. Natural Gas Deregulation: Overview of Policy Issues. Milton Russell, April 1982.

D–93. A Survey of Available Data and Methods for Developing Environmental Asset Accounts. Edith Brashares, Winston Harrington, Joy Hecht, Alan Krupnick, Henry Peskin, and David Yardas, April 1982. (Available from the National Technical Information Service.)

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D–96. Discrete Time Optimal Control Algorithm for Analysis of Long-Run Timber Supply. Kenneth Lyon and Roger Sedjo, August 1982.

FALL FORUM

Fall 1981 saw the first in an experimental series of RFF Fall Forums designed to explore an important resource or environmental topic for the benefit of leaders in industry, government, academia, foundations, and eventually the public at large. The primary purpose is not to offer easy solutions or to debate controversial topics, but rather to identify existing or emerging problems and illuminate them in a way that would improve subsequent decision making.

Regional conflict

The topic for the first forum was "Regional Conflict and National Policy," which covers terms like "the Sagebrush Rebellion" and "the Snowbelt versus the Sunbelt," controversies generated by energy severance taxes, and disputes over water, or energy, or environmental quality. The program was organized on a dual framework of history and institutions. After all, regional conflict is not new in the United States; history is replete with examples. While present conflicts may differ in degree or even in kind, and although they may require different approaches for solution, it is imprudent to proceed without examining present difficulties in the context of past regional conflicts.

And the nation has one basic set of institutions to use in the search for solutions. Powers are divided between the federal government and states in a particular way and are exercised through the legislative, judicial, and administrative branches of government. From a practical point of view, resolution of regional conflicts is not likely to get very far unless they are measured in the light of economic history and judged in a realistic way with respect to the economic, legal, jurisdictional, and political setting.

The program

Presented on October 21, 1981, in Washington, D.C., before a distinguished audience, the program drew on talent from outside as well as inside Resources for the Future:

Nathan Rosenberg, Stanford University, "History and Perspective"
Hans H. Landsberg, RFF, "Energy 'Haves' and 'Have-Nots'"
Allen V. Kneese, RFF, "Typical Cases Involving Natural Resources"
Richard B. Stewart, Harvard University, "The Legal Structure of Interstate Resource Conflicts"
Clifford S. Russell, RFF, "Externality, Conflict, and Decision"

Gilbert F. White, University of Colorado and former chairman of the RFF Board of Directors, "Summary"

Emery Castle delivered welcoming remarks and RFF Board Chairman M. Gordon Wolman chaired the luncheon session, which featured remarks by U.S. Senator Paul E. Tsongas (D.-Mass.). Board members Anne P. Carter and Laurence I. Moss chaired the morning and afternoon sessions, respectively.

Regional Conflict and National Policy, a book containing revised and extended versions of the forum presentations, was published following the close of the program year.

The 1982 Fall Forum

The second Fall Forum had as its theme "U.S. Interests and Global Natural Resources—Energy, Minerals, and Food." Held on October 21, 1982, in Washington, D.C., it will be described in next year's annual report.

WEDNESDAY SEMINAR SERIES

Wednesday seminars, held over the noon hour, expose the RFF staff to a wide range of research interests and applications. In the program year's thirty-three seminars, nine speakers came from RFF and others were affiliated with a variety of academic institutions, nonprofit research organizations, the private sector, and governmental agencies.

This year the planning of the seminars was shared by each of RFF's four divisions, with Roger A. Sedjo, Alan J. Krupnick, W. David Montgomery, and Rachael M. Lowder arranging the programs for their respective divisions.

The 1982 schedule:

David L. McNicol and Frederic Murphy, Energy Information Administration of the U.S. Department of Energy

"Analysis of Economic Effects of Accelerated Deregulation on Natural Gas Prices"

Marion Clawson, RFF
"The Federal Lands Revisited"

George Siehl, Congressional Research Service
"Congressional Options in Land Protection Policy"

John A. Miranowski, 1981–82 Gilbert White Fellow, RFF
"Optimal Management of Soil Erosion"

Robert Day, 1981–82 Forest Policy Fellow, RFF
"The Natural Resource Policy Process"

John Hoffman, U.S. Environmental Protection Agency
"Planning for Climate Change"

Steve Landefeld, Bureau of Economic Analysis, U.S. Department of Commerce
"Valuing Nonrenewable Natural Resources: The Mining Industry"

Kenneth R. Farrell, RFF
"RFF's Food and Agricultural Policy Program: A Framework for Development"

Ronald G. Ridker, The World Bank
"Korean Planning"

Benjamin Schlesinger, American Gas Association
"Outlook for Gas Energy—Supply, Demand, and Price"

Leonard P. Gianessi and Henry M. Peskin, RFF
"Applications of the RFF Environmental Data Inventory: Coastal Zone and National Water Use Planning"

Robert C. Lind, Cornell University
"Major Issues Relating to the Discount Rate"

Joe A. Oppenheimer, RFF
"Coalitions and Game Theory: Experiments and Public Implications"

Bart Ostro, U.S. Environmental Protection Agency, Office of Policy Analysis
"The Morbidity Effects of Air Pollution"

Ted McConnell, University of Maryland
"Existence and Bequest Values"

Charles Bausell, U.S. General Accounting Office
"A Market Approach to Air Pollution Control: The California Experience"

Judith Helm, Arthur D. Little
"An Evaluation of Federally Supported Experiments in Controlled Trading"

Ivy Broder, The American University
"Ambient Particulate Levels and Capital Expenditures: An Empirical Analysis"

Wallace E. Oates, University of Maryland
"Some Theoretical Issues in Environmental Economics"

Philip Verleger, Yale University and Booz-Allen and Hamilton
"Price Dynamics of an Oil Supply Disruption"

David Campbell, National Wildlife Federation
"A Reanalysis of the Water Resources Council's Principles, Standards, and Procedures"

Stanley Besen and Sheila Kirby, The Rand Corporation
"Household Demand for Electricity and Natural Gas"

Neal Potter, Montgomery County Council
"Energy from Trash: The Montgomery County Solid Waste Energy Recovery Facilities"

Milton Russell, RFF
"Natural Gas Deregulation: Overview of Policy Issues"

Marc Ross, University of Michigan
"The Decline of Materials Intensiveness in the United States: The Paper Industry as an Example"

Douglas F. Barnes, RFF
"Rural Electrification in Developing Countries"

Steve Muzzo, ICF, Inc.
"Modelling Natural Gas Supply"

David Bodde, Congressional Budget Office
"Technology and R & D Policy"

Henry Lowenstern, U.S. Bureau of Labor Statistics; and Dan Tunstall, Conservation Foundation
"Reduction in BLS Publications and CEQ Environmental Trends Report: Effects of Cutbacks on Publication of Environmental Statistics"

Kevin Maricle, Office of the General Counsel, Copyright Office of the Library of Congress
"Copyright Law"

Thomas L. Lovejoy, World Wildlife Fund, Inc.
"Biological Diversity and the Endangered Species Act"

Charles Komanoff, Komanoff Energy Associates
"Increases in U.S. Power Plant Costs in the Seventies—Measuring Them, Explaining Them"

Danny J. Boggs, Special Assistant to the President and Assistant Director for Energy, Agriculture, and Natural Resources in the Office of Policy Development
"Lead Times for Energy Production and Consumption, and Forecasting"

Beginning in September 1982, the Wednesday seminar series will devote one seminar each month to technology and natural resources. Speakers from government, business, and universities will discuss current research developments and prospects for technological advances in such areas as genetic engineering, energy technologies, pollution abatement, and materials research. Economic and social implications of these questions will also be discussed. Herbert C. Morton of RFF's Quality of the Environment Division will arrange the program for the 1982–83 technology and natural resources seminars.

STAFF CHANGES

Administration *Susan R. Greene*, RFF's new director of institutional relations, is in charge of development work with foundations and corporations and of relations with other institutions. A consultant in organizational and human resource development for nonprofit organizations and a former executive director of the Alliance for Volunteerism, she came to RFF in October 1982 from a position as vice president of programs for Youth for Understanding, Inc., an international exchange student organization. *Fisher Howe*, who joined the staff in 1978, moved from director of institutional relations and assistant to the president to a part-time post as institutional relations counselor, in which position he will assist both Mrs. Greene and President Castle. *Marian E. Lesko* has assumed new duties as word processing specialist. Replacing Lesko as purchasing assistant is *Deborah J. Womersley*, former RFF mail clerk. The new mail clerk is *Louis W. Gordon*, who previously worked in the District of Columbia's Department of Housing and Community Development. Secretary *Sylvia A. Steadham* moved from the Public Affairs Division to Central Administration. *Yolanda R. Appiah-Kubi* resigned as receptionist and was succeeded by *Claire Windsor*, a University of Maryland student.

Center for Energy Policy Research *Glen E. Gordon*, the first recipient of RFF's Fellowship in the Natural Sciences, is studying the application of thermodynamics to problems such as determining what amount of energy is required to extract and treat mineral resources. Gordon is on leave from the University of Maryland. Upon completion of his assignment at RFF, *Thomas J. Lareau* joined the benefits group within the Environmental Protection Agency's Economic Analysis Division. *Mark Lyons*, formerly program director and legal counsel at the Renewable Energy Institute, joined the staff as a fellow. Guest scholar *Deborah Shapley* completed her work on Antarctic resources and left to become the Washington editor of *Nature*. Research assistant *James L. Bresler* resigned his position to join Booz-Allen and Hamilton, Inc. *Sandra L. Glatt*, research assistant, returned to graduate school in business administration at the University of Arizona (Tucson). *John E. Jankowski, Jr.*, resigned his research assistantship to join the Office of Strategic and Policy Analysis at the Distilled Spirits Council of the United States. Research assistant *Douglas McDonald*, who transferred to CEPR from the Quality of the Environment Division, left to attend graduate school at The Johns Hopkins University. *Shelley M. Matsuba*, research assistant, resigned her position to join Inslaw, Inc., a private consulting firm. Two new research assistants joined the division: *Elizabeth E. Davis*, formerly with Energy and Environmental Analysis, Inc., and *Mary Beth Zimmerman*, formerly with the Consumer Energy Council of America. After three years in the division, *Aelese L. Carlson* resigned her position as secretary, as did *Rosalie Mangoba*, who returned to graduate school at the University of Virginia. *Pamela J. Dyson*, who previously worked as an archeologist, joined the division as secretary to Milton Russell. A student in fine arts and languages at the University of Maryland, *Elisabeth M. Hale* joined the division as secretary. Part-time secretary *Par Lena Johnson* came to RFF from the Department of Energy.

Quality of the Environment Division Fellow *Raymond J. Kopp* returned to the division following a one-year leave of absence as a visiting assistant professor of economics at the University of North Carolina at Chapel Hill. Consultant in residence *Mordechai Shechter* rejoined the Department of Economics at Haifa University in Israel after a one-year RFF sabbatical, during which he worked with Mark Sharefkin on the economic assessment of major environmental episodes. *Elizabeth A. Wilman* resigned her position as fellow and moved to Calgary, Alberta, Canada, where she is teaching in the Department of Economics at the University of Calgary. She will continue as a consultant on a project co-directed by John Krutilla on the valuation of public forest and rangeland resources. *Vickie Aaronson*, a graduate student at The Johns Hopkins University in the Department of Geography and Environmental Engineering, is working as research assistant to Mark Sharefkin. *Richard T. Carson, Jr.*, research assistant to Robert Cameron Mitchell, resigned his position to work toward his doctorate at the University of California, Berkeley. *John Mullahy*, who is working on his doctorate in economics at the University of Virginia, joined the division as a research assistant to work with Paul Portney on the benefits of setting alternative ozone and photochemical oxident standards. *David R. Yardas* resigned his research assistantship to pursue graduate studies at the University of California, Berkeley. *Betty Cawthorne*, who joined the division as secretary to Clifford Russell, formerly worked at Hydrodynamics Research Associates, Inc. *Margaret Parr-Recard* replaces *Genevieve Gremillion*, who resigned as secretary to Herbert Morton, Paul Portney, and Walter Spofford to work as a part-time division secretary. *Anne Farr* transferred from RFF's Center for Energy Policy Research to become secretary to John Krutilla and Michael Bowes. *Diane Hinton*, who resigned her position as administrative assistant, is working with the medical program of Utah Resources for Genetic and Epidemiological Research in Salt Lake City. Her replacement, *Marilyn M. Voigt*, previously worked as project assistant on the ARDEN project in the Center for Energy Policy Research. *Verna Wefald* resigned as part-time secretary to Robert Mitchell to take a position with Pre-Trial Service of District Court, the District of Columbia, while completing studies on her Juris Doctor degree at Georgetown University.

Renewable Resources Division *Robert Day*, last year's fellow in RFF's Forest and Economics Policy Program, joined the Renewable Natural Resources Foundation of Bethesda, Maryland, as its assistant executive director. Former Gilbert F. White Fellow *Christopher K. Leman* is the 1982–83 Forest Economics and Policy Fellow. *John A. Miranowski*, who worked on soil erosion and conservation as a 1981–82 Gilbert F. White Fellow, returned to Iowa State University to resume his duties as associate professor of agricultural economics. *Frank J. Popper* and *Bret Wallach*, recipients of the 1982–83 Gilbert F. White Fellowships, have joined the division. Popper, an independent consultant and political scientist, will examine planning for locally unwanted land uses; and Wallach, an associate professor of geography at the University of Oklahoma, will study land and water use on the High Plains. *Trang T. Vo*, who recently received her master of science degree from the University of Maryland, joined the Food and Agricultural Policy Program as research assistant. After four years as secretary to the Forest Economics and Policy Program, *Lorraine Van Dine* resigned her position to devote more time to her musical career. Her replacement, *Cynthia L. Stokes*, earned her master's degree in biology from Indiana University. *Mimi W. Rubin* has replaced *Ruth Hayn* as secretary to Kenneth R. Farrell and Irving Hoch.

Public Affairs Division *Patricia M. Parker* moved from the Quality of the Environment Division to become secretary to Kent Price. *Mary Ellen McAllister*, a student at George Washington University, and *Jacqueline A. Rooney*, a Georgetown University student, have joined the division on a part-time basis in the position previously held by *Nati T. Atienza*.

OUTSIDE STAFF ACTIVITIES

Julia C. Allen Presented a paper (with Douglas F. Barnes) on "Social Forestry in Tanzania: Why People Don't Plant Trees," at the annual meeting of the American Association for the Advancement of Science.

Jack Alterman Participated in meetings of the Committee on Energy Statistics of the American Statistical Association, with the administrator and staff of the Energy Information Administration (EIA) of the U.S. Department of Energy, to discuss and provide technical advice on specific aspects of the work of EIA.

Douglas F. Barnes Presented a paper (with Julia Allen) on "Social Forestry in Tanzania: Why People Don't Plant Trees," at the annual meeting of the American Association for the Advancement of Science; participated in "Community Forestry in Developing Nations Workshop" at the U.S. Agency for International Development; lectured on "Rural Electrification in Developing Nations" to developing country participants in the Conventional Energy Training Project sponsored by the Agency for International Development.

Douglas R. Bohi Testified (with Harry Broadman and David Montgomery) on oil import policy before the U.S. House Subcommittee on Environment, Energy, and Natural Resources of the Government Operations Committee; presented a paper (with David Montgomery) on "Tariffs and the Economic Costs of an Oil Disruption" at the third annual North American meetings of the International Association of Energy Economists in Houston, Texas; and was visiting professor at the Centre of Policy Studies, Monash University, Melbourne, Australia, presenting two seminars on energy security policy and drafting two chapters for a book on Australian energy policy issues.

Blair T. Bower Visiting lecturer, Graduate Department of City and Regional Planning, University of North Carolina at Chapel Hill; member of the editorial board of the *Journal of Soil and Water Conservation;* member of the National Advisory Council to the *Natural Resources Journal;* visiting fellow to the East–West Center, Honolulu, Hawaii; made presentations on management of coastal waters at seminars in Tsukuba and Tokyo, Japan, sponsored by the International Federation of Institutes for Applied Studies; and presented seminars on regional–residuals environmental quality management to the Department of Systems Engineering, Yamanashi University, Kofu, Japan, and at the Lyndon Baines Johnson School of Public Affairs of the University of Texas at Austin.

Michael D. Bowes Consultant to the U.S. Forest Service's Methodology Development Unit.

Harry G. Broadman Presented a paper on "The Pattern of Petroleum Investment in Non-Oil Developing Countries: A Conceptual Framework of Company and Country Roles" to the United Nations *ad hoc* meeting of petroleum and energy experts, "Energy in the Eighties"; presented a paper on "The Social Cost of Imported Oil: Theoretical Issues and Empirical Estimates" at the Institute of Gas Technology conference on Energy Modeling IV: Planning for Energy Disruptions; invited participant at the Harvard University conference on Energy Security Policy Implementation Issues, at the Wilson Center Workshop on U.S.–East Asian Energy Security; at the Americans for Energy Independence conference on The Oil Glut: How Deep and How Long; and at the Heritage Foundation's Energy Policy Workshop; and testified (with Douglas Bohi and David Montgomery) on oil import tariff policy before the U.S. House of Representatives Subcommittee on Environment, Energy, and Natural Resources of the Government Operations Committee.

Emery N. Castle Moderator for the U.S. Department of Agriculture's 58th Annual Outlook Conference on land and water issues; served on review board of visitors of the School of Forestry and Environmental Studies at Duke

University; delivered an address on "Resource Adequacy, Global Development, and International Relations," at the annual meeting of the American Association for the Advancement of Science; attended the meeting of the Federation of Scientific Agricultural Societies at Hospitality House in Virginia; attended an Economic Research Service workshop on land values; member of the Texas Energy and Natural Resources Advisory Council for review of the Texas Five-Year Energy Research Plan, which identifies technologies and problem areas of particular importance to the State of Texas; spoke to the National Economists Club on U.S.–Japanese agricultural trade relations; participated in a review of the Conquest of Hunger Program of the Rockefeller Foundation in New York and made a presentation on the productivity of U.S. agriculture and its potential contribution in meeting global food needs; spoke on "U.S. Agriculture in a Global Context" at the Food in the West symposium of the Western Governors' Conference in Gleneden Beach, Oregon; testified before the U.S. House of Representatives Subcommittee on Natural Resources, Agriculture Research, and Environment; gave Fellows lecture on "Agriculture and Natural Resource Adequacy," to the joint meeting of the American Agricultural Economics and Western Agricultural Economics Societies in Logan, Utah; and attended conference on Asian water problems, sponsored by the East–West Center in Honolulu.

Marion Clawson President of the Forest History Society, and alternate member on its National Resources Council; member of the editorial board of *Landscape Planning*; member of the advisory board of *The Environmental Professional*; participated in a conference on recreation, sponsored by National Recreation and Parks Association, at the Aspen Institute for Governance, Queenstown, Maryland; participated in a program commemorating Franklin D. Roosevelt's one-hundredth birthday, at Hofstra University; presented the summary discussion at Agricultural Council of America conference; addressed student convocation of Utah State University and presented a paper at the university's conference on Politics Versus Policy: The Public Lands Dilemma; participated in discussion on housing problems in relation to forestry at a congressional breakfast; presented paper on housing in relation to the forest industry, at the American Forest Institute; met with staff persons and gave seminars on natural resource planning in the United States, at three Irish universities; participated in a workshop on Land Protection and Management, sponsored by the Subcommittee on Public Lands, of the U.S. Senate Committee on Energy and Natural Resources; presented a paper on "Reassessing Public Lands Policy" at a conference on Private Rights and Public Lands sponsored by the Heritage Foundation; and participated in a meeting of the City Club, Portland, Oregon, to discuss alternative federal land management programs.

Pierre R. Crosson Member of the Advisory Committee to the Food and Agricultural Program, International Institute for Applied Systems Analysis, Laxenberg, Austria; member of a soils panel organized by the American Association for the Advancement of Science (AAAS) for a project on "Natural Resource Inventories and Baseline Studies: Methods for Developing Countries"; member of a National Research Council task force on the U.S. National Resource Inventories; chairman of the Task Force on Erosion and Soil Conservation Policy of the American Agricultural Economics Association; discussant of a background paper at a workshop on soil erosion held at the Conservation Foundation; participated in a Purdue University workshop on research into soil erosion–productivity relationships; discussant of a paper on soil erosion and U.S. export policies at a Columbia University symposium; gave a seminar at Iowa State University on resource and environmental impacts of trends in U.S. agriculture; spoke on land degradation and agricultural development at the annual meeting of the Society for International Development, and on the implications for

U.S. soil conservation policy of uncertainty about the long-run productivity effects of soil erosion at the annual meeting of the American Agricultural Economics Association; gave a paper on the relationship between U.S. agricultural exports and the environment at the annual meeting of the AAAS; testified on the potential uses of data from the National Resources Inventories for analysis of erosion and related soil conservation issues before the U.S. House Subcommittee on Department Operations, Research and Foreign Agriculture; participated in meetings of the Project Advisory Committee to the 1985 National Resources Assessment of the U.S. Department of Agriculture (USDA); spoke to the USDA's Joint Council on Food and Agricultural Sciences; and was elected secretary of the Association of Environmental and Resource Economists.

Joel Darmstadter Presented a paper (with Thomas Lareau) on "Prospective Changes in the Pattern of Household Expenditures: The Role of Energy" at a meeting of the International Association of Energy Economists; participated in the Brookings Institution's Conference on Energy and Housing in the 1980s; appointed to a National Science Teachers Association steering committee to advise on revision of the NSTA *Energy-Environment Handbook;* appointed to a Gas Research Institute steering committee on GRI's Long-Range Technology Plan; member of the editorial committee of the *Annual Review of Energy;* and consulting editor of *Environment.*

Joy Dunkerley Prepared a briefing paper on "Energy Issues on the International Agenda" at a session organized by the Overseas Development Council to brief the press in connection with the Cancun Summit; presented a paper on "Energy and the Developing World," at the second International Energy Symposium held in connection with the 1982 World's Fair in Knoxville, Tennessee; named president-elect of the International Association of Energy Economists at their third annual North American meeting held in Houston, Texas; chaired session on "Public Policy Analyses Methods," and gave a paper on "Energy Strategies for Developing Nations" at IAEE meeting; presented a paper on "Interfuel Substitution" at the first annual meeting of the German affiliate of the IAEE in Bonn, Germany; lectured on "Energy and World Development" at the World Bank's Economic Development Institute in a seminar on Current International Development Issues held for senior Washington diplomats; participated in a panel discussion on "Developing Country Energy Prospects to the Year 2000: Demand Scenarios and Supply Options" at the annual conference of the Society for International Development in Washington, D.C.; spoke on "The Impact of the Energy Crisis on Third World Development" to participants of the Development Studies Program at the U.S. Agency for International Development; served as panelist in session on "Seeking a Global Balance," organized by Rep. Ted Weiss (D–N.Y.) as part of a symposium on "American Foreign Policy: Our Role in the Changing World"; spoke on "Energy Futures in the Third World" at the University of Kentucky's seminar on the Third World and later taped a half-hour interview for the university television station; conducted two weeks of discussions on Energy Planning at a meeting of the Association of South East Asian Nations' energy planners sponsored by the Asian Institute of Technology in Bandung, Indonesia.

Kenneth R. Farrell Consultant to presidential mission on Egyptian agricultural development; chairman of the Social and Behavioral Sciences Committee in the Graduate School of the U.S. Department of Agriculture (USDA); member of the Agricultural Committee of the National Planning Association; of the Federal Statistics Users Committee; of the Agricultural Export Advisory Committee of the Agricultural Council of America; and of the Fellows Election Committee of the American Agricultural Economics Association; reviewer for *American Journal* of *Agricultural Economics* and *Agricultural Economics Research;* presented seminars on food and agricultural resource use policy at Michigan State University, the University of California, Davis, the University of Santa Clara, and the Economic Research Service of the USDA; presented papers at the University of Maryland on "Research Perspectives on Food and Agricultural Policy in the 1980s"; at the Midwestern Conference on Food, Agriculture and Public Policy on "Effects of the Economic Recovery Act and Supply-Side Economics on Agriculture and Rural America"; at the Society of Government Economists on "Food and Agricultural Policy Issues of the 1980s"; at the USDA Conference on Micro-Models of Agriculture, on "Implications of National Agricultural Policies in Modeling Behavior of Farm Firms; at the Kansas Agricultural Experiment Station on "Research Challenges for Land Grant Universities"; at the Pomona College Conference on Food, Land, and Power, on the "The Economic Sustainability of US Agriculture"; at the Northeast Agricultural Economics Council and National Economics Club, on "Agriculture in the 1980s: Current and Emerging Policy Issues"; testified on agriculture and natural resources before the U.S. House Committee on Agriculture; and discussed papers at the annual meeting of American Agricultural Economics Association and at the University of California conference on Impacts of Limited Water Agriculture in the Arid West, held in Asilomar.

Kenneth D. Frederick Member of the Aquatic Ecosystems Panel of the American Association for the Advancement of Science project on "Natural Resource Inventories and Baseline Studies: Methods for Developing Countries; and presented paper (coauthored with Allen V. Kneese) on "The Competition for Water in the West" at a University of California conference on Impacts of Limited Water for Agriculture in the Arid West, held in Asilomar.

Leonard P. Gianessi Consultant on pollution control costs to the Environment Directorate of the Organisation for Economic Co-operation and Development, Paris, France; and consultant to the European Economic Community.

Irving Hoch Presented seminars on "Explaining Farm Real Estate Prices," as part of the U.S. Department of Agriculture (USDA), Economic Research Service, Natural Resources Economics seminar series, and on "Farm Real Estate Price Components," to the Department of Agricultural Economics of the University of Maryland; advisor to the Transportation, Industrial and Model Coordination Branch of the U.S. Energy Information Administration on the development of energy statistics; participated in workshop on Energy Conservation in the Built Environment held by Advisory Board on the Built Environment (ABBE) of the National Research Council, National Academy of Sciences; member of the advisory committee to ABBE; member of the National Advisory Committee for 1983 American Solar Energy Society Annual Conference; and member of the editorial board of *The Journal of Urban Economics.*

Allen V. Kneese Presented a paper on "Principles of Regulatory Analysis" at the Public Interest Economics Foundation Conference on Regulatory Impact Analysis; attended Conference on Health, Safety, and Environmental Regulation, sponsored by the Center for the Study of Government Regulation of the American Enterprise Institute for Public Policy Research; participated in a joint Navajo–National Academy of Sciences working group in a meeting on land use policy and land development issues in Window Rock, Arizona; participated in the session on "Can or Should Futures Projects be Designed on a Regional Basis?" at the States Futures/Planning Directors Meeting in San Francisco, sponsored by the Western Office of the Council of State Governments; panelist on "Paradoxes of Resources Development in the Arid West," at the annual meeting of American Association for the Advancement of Science; presented a paper (with Ralph C. d'Arge) on "Some Legal, Ethical, Economic, and Political Aspects of Transfrontier Pollution" at the American Chemical Society symposium on The Transboundary Effects of Acid Rain, held in Las Vegas, Nevada; panelist on "The Federal Water Pollution Control Act: Are Major Changes in Order?" in the Public Interest Economics Foundation's annual lectures on economic policy issues; lectured on "The Problems of Indirect Costs" in the short course on "New Sources of Water for Energy Development and Growth: Interbasin Transfers," offered by the Natural Resources Law Center of the University of Colorado School of Law, Boulder; presented a review lecture on the "Economic Analysis of Environmental Problems," at symposium on Integration of Economy and Ecology—An Outlook for the Eighties, sponsored by the Marcus Wallenberg Foundation for International Cooperation in Science, in Stockholm, Sweden. Member of the Policy Advisory Committee of Consortium on Energy Impacts (CEI) under the auspices of University Corporation for Atmospheric Research, of the Panel of Experts, of the Bilateral U.S.–Federal Republic of Germany Exchange on the Use of Incentive-Based Pollution Abatement Policies, sponsored by Public Interest Economics Center, of the Committee for Economic Recovery, of the Committee for Progressive Economics, of the Advisory Board of the Society for Risk Analysis, of the Liaison Subcommittee on Resources and Environment of NAS Advisory Committee on the International Institute for Applied Systems Analysis (IIASA), of the Advisory Committee on Science and Technology for Navajo Development, NAS/NRC Committee under the Board on Science and Technology for International Development, of the National Science Foundation/Policy Research and Analysis Advisory Committee and its Subcommittee on Environment, Energy, and Resources, and of the High Plains Consulting Panel to Camp Dresser & McKee Inc., Water Resources Division; consultant to the Environment Programme of the Organisation for Economic Co-operation and Development in Paris, and to the Los Alamos National Laboratory; coeditor of the *Journal of Environmental Economics and Management*, and member of the editorial boards of *Risk Analysis; Journal of Environmental Risk; Southwest Review*; and *Environmental Ethics*.

Raymond J. Kopp Chaired session on "Special Topics in Production Modeling" at the annual meeting of the Southern Economics Association and presented a paper on "Modeling Nonneutral Technical Change"; presented a paper at the International Institute of Applied Systems Analysis (IIASA) Conference on Critical Nonfuel Minerals in Vienna; and was visiting assistant professor of Economics at the University of North Carolina at Chapel Hill.

Alan J. Krupnick Presented a paper on "What Makes EPA Run? An Empirical Analysis of EPA Rulemaking Behavior," at the Berlin, Germany, conference on "Implementation of Environmental Regulation: International Comparisons," sponsored by the Berlin Science Center and the Policy Sciences Program of the Florida State University; was a consultant to the University of Missouri on the design of a marketable permits program for the state of Missouri; and presented a seminar on "Regulatory Reform at EPA," at the University of Missouri.

John V. Krutilla Resident advisor to the Association of Environmental and Resource Eonomists; member of the advisory committee to the Wilderness Society's Economic Policy Department; consultant to the U.S. Forest Service Research Unit on valuation of forest outputs; attended various Forest Service land use planning workshops; presented capstone address at the combined meetings of the Society of American Foresters and the Soil Conservation Society; served as the public member of the Society of American Foresters' Committee on Educational Policy; and was visiting scholar at Virginia Polytechnic Institute and State University.

Hans H. Landsberg Member of the Energy Research Advisory Board of the U.S. Department of Energy, serving on its Multipurpose National Laboratories and Conservation panels; member of the Board of Mineral and Energy Resources of the National Academy of Sciences; addressed three executive seminars of the U.S. Chamber of Commerce; chaired an advisory committee to the synfuels study of the Office of Technology Assessment; participated in Sessions II and III of the International Energy Symposium of the Knoxville World's Fair; advisor to the Regional Studies Group of the Energy Division of the Oak Ridge National Laboratory; as member of the Year 2000 Committee, assisted in developing their research and action program; panelist at the session on Energy R & D Trends at the annual meeting of the American Association for the Advancement of Science; lectured twice at the Foreign Service Institute of the U.S. Department of State; addressed the National Economists Club on U.S. mineral issues and policies; discussant at the Conference on Energy and Security, sponsored by the Institute of International Affairs (Italy); conducted seminars on U.S. energy issues, and policies, and on energy R & D trends at the Universities of Trento and Trieste (Italy), and at the Nuclear Energy Institute in Jülich (Germany); delivered tutorial lecture on mineral issues and policies to the Biennial Conference on National Materials Policy, conducted by the Federation of Materials Societies; member of the editorial boards of *Daedalus*, *Resource Policy*, and *Energy Journal*; and member of advisory committees to the Resource Systems Institute, East–West Center, Honolulu, Hawaii, to the Brookhaven National Laboratory, Department of Energy and Environment, and to the Assistant Secretary of State for Ocean, Environment and Science.

Thomas J. Lareau Presented paper (coauthored with Joel Darmstadter) on "Prospective Changes in the Pattern of Household Expenditures: The Role of Energy" at the third annual meeting of the International Association of Energy Economists in Houston.

Christopher K. Leman Presented paper (with Robert H. Nelson) on "Diagnosing American Federalism: A Modest Case for the States," at a symposium on Federalism and the Environment: A Change in Direction, sponsored by *Environmental Law*, in Portland, Oregon; spoke on "Thoughts of a Political Scientist on the Economists' Case for Selling Off the Public Lands," at a panel on "Do We Need the Interior Department?—The Libertarian Perspective Examined," at the annual meeting of the Eastern Economics Association; presented a talk on "Les provinces canadiennes: importance et orientations de leurs relations internationales," at the Thirteenth Quebec Conference on International Relations, in Québec City; testified on "Progress Toward Efficient and Sustainable Agricultural Systems: Oversight on U.S. Department of Agriculture Programs and Activities" before the Department Operations, Research, and Foreign Agriculture Subcommittee of the U.S. House Committee on Agriculture; testified on the Soil and Water Resources Conservation Act of 1977 at a hearing of the Conservation, Credit, and Rural Development Subcommittee of the U.S. House Committee on Agriculture; chaired panel on "Federalism and the Welfare State," at the annual meeting of the Canadian Political Science Association, Ottawa, Ontario; chaired panel on "Implementation of State Forest Resource Plans," at the fourth annual State Forest Resource Planning Workshop, U.S. Forest Service, Northeastern Region, in Rehoboth Beach, Delaware; co-chair (with William Hyde) and discussant for panel on "Public Resources Management: National Versus Local Perspectives," at the third annual meeting of the Association for Public Policy Analysis and Management, Washington, D.C.

Mark Lyons Attended and reported on the meeting of the United Nations Interim Committee on New and Renewable Sources of Energy in Rome, Italy, for several solar energy publications.

John A. Miranowski Presented a paper on "Optimal Management of Soil Productivity and Environmental Quality" to the Department of Economics of North Carolina State University in Raleigh; discussant for the session on "Simulation Models of the Farm" at the Airlie House Conference on Modeling and Evaluating Policy and Institutional Impacts on Farm Firms; was panelist for the Soil Resources Conference; presented seminars on "Soil Erosion and Market Failure" at the University of Maryland, on "Erosion Control Policy for Soil Productivity and Environmental Quality Management" at the Pennsylvania State University, on "Implicit Prices for Soil Characteristics" at the Institute for Research on Land and Water Resources, on "Soil Erosion: Who Should Care?" as part of the U.S. Department of Agriculture, Economic Research Service, Natural Resources Economics seminar series, and addressed the U.S. Feed Grains Council on "Soil Erosion: An Urban Issue?"; member of the Committee on Impacts of Emerging Agricultural Trends on Fish and Wildlife Habitat of the National Research Council, National Academy of Sciences; and was chairman of the Current Research Information Service Committee of the American Agricultural Economics Association.

Robert Cameron Mitchell Lectured at the Foreign Service Institute of the U.S. Department of State; presented a paper on "Rationality and Irrationality in the Public's Perception of Nuclear Power" to the annual meeting of the American Association for the Advancement of Science; presented a paper on "Consumerism and Environmentalism in the 1980s: Competitive or Companionable Social Movements?" to a workshop sponsored by the Marketing Science Institute and the University of Maryland's Center for Business and Public Policy, Wye Plantation, Maryland; presented a paper on "Local Siting of Energy Facilities and Toxic Waste Dumps and Concern About Risk" to the American Association for Public Opinion Research annual meeting, Hunt Valley, Maryland; presented a paper (with R. Kenneth Godwin) on "The Implications of Direct Mail for Political Organizations" to the annual meeting of the American Political Science Association, Denver; and served as a corresponding editor for the newsletter of the Environmental Sociology Section of the American Sociological Association.

W. David Montgomery Presented paper (with Douglas R. Bohi) on "Tariffs and the Economic Costs of an Oil Disruption" at the third annual North American meeting of the International Association of Energy Economists in Houston, Texas; presented paper on "The Role of Import Reduction in Enhancing Energy Security" at the Allied Social Science Association meetings in Washington, D.C.; discussant at sessions on "Modelling and Measuring the Costs and Benefits of Government Constraints" and "Implementing Regulatory Change: Three Case Studies" of the American Economic Association meetings in Washington, D.C.; participant in the Scientists' Institute for Public Information conferences on "Natural Gas Issues" and "Energy Emergency Planning"; testified at U.S. Senate Energy Committee oversight hearings on the Strategic Petroleum Reserve; testified (with Douglas Bohi and Harry Broadman) on oil import policy before the U.S. House Subcommittee on Environment, Energy, and Natural Resources of the Government Operations Committee; member of Energy Modelling Forum working group on "Macroeconomic Impacts of Energy Price Shocks"; and member of the editorial board of *The Energy Journal*.

Herbert C. Morton Moderator of the opening session of the fourth annual convention of the Society for Scholarly Publishing; consultant to the Russell Sage Foundation, the National Endowment for the Humanities, and the Ford Foundation; publisher of *Watch on Washington*, convention book of the Society of Professional Journalists; member of the advisory board of the National Academy of Sciences Press; member of the Committee on Scholarly Communication of the American Council of Learned Societies; chairman of the publications committee of the

Joint Council on Economic Education; and consultant to Nova University, Fort Lauderdale, Florida.

Scott A. Noll Panel discussant on industry and economic development at the conference on "Renewable Resources: Global Perspectives," sponsored by the United Nations Development Programme and the Seattle Metrocenter YMCA; presented paper on "U.S. Energy Policy in Flux: Divergent Views of the Carter and Reagan Administrations" at a conference sponsored by the Vasterbottens Sparbank and University of Umea in Sweden; panel discussant on "Near-term Outlook for World Oil Prices," sponsored by the Congressional Budget Office; spoke to high school students attending the District of Columbia's Closeup Foundation domestic energy policy seminars; member of the editorial board of the American Solar Energy Society; chairman of the board of the STAR Foundation, a nonprofit Maine-based organization promoting intergenerational educational activities through the demonstration, management, and use of locally available renewable resources; member of the 1982 advisory board for the Georgetown University chapter of the International Association of Economics and Business Students (AISEC); and consultant to the Los Alamos National Laboratory.

Harry Perry Member of Research Coordination Panel of the Gas Research Institute, of the Board of Mineral and Energy Resources of the National Research Council, of the Committee on Climate of the American Association for the Advancement of Science, of the Argonne Associated Universities review committee for the chemical engineering program, of the Committee on Disposal of Excess Spoils of National Research Council, and of the advisory board of "Inform" for its Department of Energy-sponsored study on environmental effects and control of air pollution; presented a talk on "International Trade in Steam Coal" at Canberra, Australia, to a joint Australian–Japanese Conference on Coal Exports; testified on disposal of excess spoil during surface mining of coal before the U.S. House of Representatives Interior and Insular Affairs Committee; and conducted a graduate seminar on coal economics at the University of West Virginia.

Henry M. Peskin Attended U.S. Geological Survey Data Users Workshop; presented a paper on "Applications of the RFF Environmental Data Inventory," at the Annual Meeting of the Southern Economic Association, New Orleans, Louisiana; attended American Enterprise Institute Conference on Regulation; attended conference on Indicators of Organizational Charges sponsored by the Social Science Research Center, and critiqued papers by Albert Biderman and James Coleman; presented a paper on "National Water Quality Policy: How Effective Is It?" at the Philadelphia meeting of the American Geophysical Union; and attended the American Enterprise Institute's conference on Research on the Use of Incentive-based Pollution Abatement Policy in the Federal Republic of Germany and the United States.

Paul R. Portney Testified on "Setting Ambient Air Quality Standards Under the Clean Air Act," before the Subcommittee on Health and the Environment of the Energy and Commerce Committee of the U.S. House of Representatives; discussant for a panel on "Amending the Clean Air Act," sponsored by the Woman's National Democratic Club, and for a similar panel sponsored by Women in Government Relations; interviewed by the Voice of America about "Environmental Regulation in the U.S. and Abroad;" was adjunct professor of The Washington Campus, a consortium of thirteen graduate schools of business, teaching two courses in government regulation; reviewed the project, "Economic Incentives in Environmental Policy in the U.S. and West Germany," sponsored by the U.S. Environmental Protection Agency and the German Marshall Fund; and participated in the Workshop on Benefit–Cost Analysis, sponsored by the U.S. National Committee of the World Energy Conference.

William Ramsay Gave a talk on "Energy and the World Context" at a seminar sponsored by The American University; and spoke on "Energy and the Environment" to a group of utility executives from the state of Washington.

Clifford S. Russell Presented a paper (with Joe Oppenheimer) on "Tempest in a Teapot: The Analysis and Evaluation of Non-User Trading in Markets for Pollution Permits" at a conference on regulatory reform, transferable permits, and enhancement of environmental quality, sponsored by the University of Wisconsin Sea Grant Program; presented a paper on "Marine Ecosystem Modeling: The Potential for Application in (Pollution Control) Benefit Measurement," at a workshop on marine ecosystem modeling sponsored by the National Oceanic and Atmospheric Administration; lectured on U.S. recreational fisheries management at a seminar sponsored by the Water Space Amenity Commission of the United Kingdom, at Tadley Court, Hampshire; spoke on environmental regulation and steel production at a conference on problems and prospects for the U.S. steel industry, sponsored by Amherst College and the American Iron and Steel Institute; participated in a continuing workshop on risk, consent, and air organized by the Center for Philosophy and Public Policy of the University of Maryland; served as a consultant to a Vanderbilt University study of Tennessee water issues, as a director and chairman of the membership committee of the Association of Environmental and Resource Economists, as a member of the Committee on Economic Research of the American Water Works Association, and as a member of the editorial board of *Economic Perspectives* and *Land Economics*.

Milton Russell Presented a talk on "Nuclear Energy Prospects: The Broader Setting" to the International Conference on Nuclear Energy, sponsored by the World Nuclear Fuel Market; chaired sessions on "Oil Market Dynamics During a Disruption" and "Regulatory Issues: Natural Gas, Part I" at the third annual North American meeting of the International Association of Energy Economists; member of the editorial boards of *Science, Energy Journal, Review of Regional Economics and Business, Journal of Cultural Economics*; adviser to the Committee for Economic Development on statement on "Energy Prices and Public Policy"; presented a talk on "Energy from a National and Global Perspective" at the 1982 Wyoming Energy Conference in Casper; presented a paper on "Overview of Natural Gas Policy Issues: A Preliminary Assessment" at the American Enterprise Institute Conference on Deregulation of Natural Gas; member of the Advisory Committee for the Energy Division of Oak Ridge National Laboratory; appeared on the television program "This Week with David Brinkley"; interviewed for Mutual Radio; presented the workshop summary and outlined policy choices for the "Workshop on the Implications of a Near- and Mid-Term Oil Surplus," sponsored by the U.S. Department of State; spoke on "Oil Pricing in the 1980s," and participated in a panel discussion at the Brookings Institution's Annual Energy Forum; and was a discussant at a session on energy security at the fourth international conference of the International Association of Energy Economists at Churchill College (Cambridge, England).

Roger A. Sedjo Delivered Thirty-Second H. R. McMillan Invited Lecture on "Intensive Management Options in the Pacific Northwest Compared with Opportunities in Other Regions" to the Faculty of Forestry of the University of British Columbia in Vancouver; discussed short- and intermediate-term timber market prospects with the British Columbian Council of Forest Industries; presented a paper on "The Effect of Federal Control on Log Exports" at the Eastern Economics Association meeting; lectured on "An Optimal Control Theory Model of Long-Term Timber Supply" to the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, and worked on the IIASA's Forest Sector Project; presented a paper on "Application of Optimal Control Theory to Estimate

Long-Term Supply of Timber" at the North American Conference of Forest Sector Models, in Williamsburg, Virginia; attended conference of the Inter-American Development Bank on Forest Sector Development in Latin America; presented testimony to the U.S. Senate Agricultural Committee on timber sales contract terminations; participated in a USDA meeting which suggested revisions in Forest Service regulations; testified on the "Current Crisis in Housing and Its Effects on the Forest Products Industry" before the U.S. House Agricultural Committee; consultant to the Office of Technology Assessment on forestry projects; participated in the Political Economy Research Center's Conference on "Land Use and Resource Development," Big Sky, Montana; lectured to Manchester Forum on "U.S Forest Policy: Private and Public Options"; participated in USDA-sponsored meeting to discuss new Forest Service timber sales procedures; treasurer-elect of the Association of Environmental and Resource Economists; and member of U.S. Liaison Subcommittee of the Forest Industry Project of IIASA.

Mark F. Sharefkin Visiting scientist, Resources and Environment Division of the International Institute for Applied Systems Analysis, Laxenburg, Austria.

Walter O. Spofford, Jr. Member, National Academy of Sciences (NAS) Advisory Committee on the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria; chairman, Liaison Subcommittee on Resources and Environment, NAS Advisory Committee on the IIASA; member, Executive Subcommittee for International Cooperation in Systems Analysis Research, NAS Advisory Committee on the IIASA; member, editorial board, *Journal of Environmental Economics and Management*; member, U.S. Committee on Scientific Hydrology (representing the American Geophysical Union); member, IIASA–U.S. Planning Group; co-chairman of the session on Municipal and Industrial Waste Disposal on the West Coast at *Oceans 82*, sponsored by the National Oceanic and Atmospheric Administration.

Michael A. Toman Completed dissertation on *Intertemporal Optimization, The Hotelling Theory, and Nonrenewable Resource Markets* for a Ph.D. in economics at the University of Rochester; and presented paper on "the Benefits of International Energy Cooperation: A Theoretical Perspective" at the 1982 annual meetings of the Southern Economic Association.

Elizabeth A. Wilman Presented a paper on "Coastal Zone Management and the National Interest" at a meeting of the Association for Public Policy Analysis and Management; gave a seminar on "Economic Values of Forest Recreation" as part of the women's seminar series at the Yale School of Forestry and Environmental Studies; prepared a paper on "Recreation Benefits from Public Lands" for a U.S. Forest Service Conference on the State of the Art in the Valuation of Wildlife Resource Benefits; consultant to the U.S. Forest Service on a research project to recommend wildlife, fish, and recreational activity values to be used in the 1985 RPA Program development; and served as treasurer of the Association of Environmental and Resource Economists.

OUTSIDE STAFF PUBLICATIONS

Douglas F. Barnes

"Rural Literacy and Agricultural Development: Cause or Effect," *Rural Sociology*, vol. 37, no. 2, Summer 1982.

Douglas R. Bohi

(With Harry Broadman and David Montgomery) "Is the Oil Import Fee Sound Energy Policy?" *Challenge*, September–October 1982.

(With W. David Montgomery) "Social Cost of Imported Oil and U.S. Import Policy," *Annual Review of Energy*, vol. 7, 1982.

Blair T. Bower

(With Gordon L. Brady) *Air Quality Management: Quantifying Benefits*, Research Report No. 7, East–West Environment and Policy Institute, Honolulu, Hawaii, November 1981.

(With Gordon L. Brady and Hyder Lakhani) "Benefit–Cost Analysis in Air Quality Management: The Case for Less Developed Countries," *Journal of Environmental Management*, vol. 14, 1982.

Michael D. Bowes

(With John B. Loomis) "On the Use of Travel Cost Models With Unequal Zonal Populations: A Reply," *Land Economics*, vol. 58, no. 3, August 1982.

Harry G. Broadman

"The Social Cost of Imported Oil: Theoretical Issues and Empirical Estimates," in *Energy Modeling IV: Planning for Energy Disruptions*, Institute of Gas Technology, Chicago, Ill., 1982.

"The Pattern of Petroleum Investment in Non-Oil Developing Countries: A Conceptual Framework of Company and Country Roles," in *Report on the United Nations* Ad Hoc *Meeting of Petroleum and Energy Experts, "Energy in the Eighties,"* United Nations, New York, N.Y., 1982.

(With Douglas R. Bohi and W. David Montgomery) "Is the Oil Import Fee Sound Energy Policy?" *Challenge*, September–October 1982.

Sterling Brubaker

"Societal Problems and Research Needs in Civil Engineering: Air, Water, Food," in Carl Monosmith, chairman, *Addressing Societal Needs of the 1980s Through Civil Engineering Research: Proceedings of the Workshop*, American Society of Civil Engineers, New York City, 1982.

(With Emery N. Castle) "Alternative Policies and Strategies to Achieve Soil Conservation," in Harold G. Halcrow, Earl O. Heady, and Melvin Cotner, eds., *Soil Conservation Policies, Institutions, and Incentives*, Soil Conservation Society of America, Ankeny, Iowa, 1982.

Richard T. Carson, Jr.

(With Clifford S. Russell and William J. Vaughan) "A Survey of Recreational Fee Fishing Enterprises," *Farm Pond Harvest*, vol. 16, no. 4, 1981.

Emery N. Castle

"How to Change Agricultural Research and Extension to Make It a Better Investment," in Harold Guither, Robert Spitze, and David Chicoine, eds., *Proceedings of the Thirty-First National Public Policy Education Conference*, Farm Foundation, Oak Brook, Ill., 1982.

"Land, People, and Policy: A National View," *Journal of Soil and Water Conservation*, vol. 37, no. 1, January–February 1982.

(With Sterling Brubaker) "Alternative Policies and Strategies to Achieve Soil Conservation," in Harold G. Halcrow, Earl O. Heady, and Melvin L. Cotner, eds., *Soil Conservation Policies, Institutions, and Incentives*, Soil Conservation Society of America, Ankeny, Iowa, 1982.

(With Irving Hoch) "Farm Real Estate Price Components, 1920–78," *American Journal of Agricultural Economics*, vol. 64, no. 1, February 1982.

Marion Clawson

"Competitive Land Use in American Forestry and Agriculture," *Journal of Forest History*, vol. 25, no. 4, October 1981.

"Conservation and National Forest Management," Letter to Editor, *Regulation*, November–December, 1981.

"Conserving the Soil," in Don F. Hadwiger and Ross B. Talbot, eds., *Food Policy and Farm Programs*, Academy of Political Science, New York, N.Y., 1982.

"An Economic Classification of U.S. 'Commercial Forests'," *Journal of Forestry*, vol. 79, no. 11, November 1981.

"Land Use: Problems, Issues and Policies," *Looking Ahead*, vol. 6, no. 3, December 1981.

"Land-Use Trends," in Amos H. Hawley and Sara Mills Mazie, eds., *Nonmetropolitan America in Transition*, University of North Carolina Press, Chapel Hill, 1981.

"Natural Resources of the Great Plains in Historical Perspective," in Merlin P. Lawson and Maurice E. Baker, eds., *The Great Plains: Perspectives and Prospects*, University of Nebraska Press, Lincoln, 1981.

"Review of Farmlands Preservation—the State of the Art," *Landscape Planning*, vol. 8, no. 4, December 1981.

(With Philip E. Graves) "Rural to Urban Migration: Population Distribution Patterns," in Lee R. Martin, ed., *A Survey of Agricultural Economics Literature*, vol. 3, *Economics of Welfare, Rural Development, and Natural Resources in Agriculture, 1940s to 1970s*, University of Minnesota Press, Minneapolis, 1981.

(With Roger A. Sedjo) "Forest Policy," in Charles W. Howe, ed., *Managing Renewable Natural Resources in Developing Countries*, Westview Press, Boulder, Colo., 1982.

Review of *Land Use in America*, by Richard H. Jackson, John Wiley & Sons, New York, N.Y., 1981; and *Land in America: Its Value, Use and Control*, by Peter Wolf, Pantheon Books, New York, N.Y., 1981 in *American Planning Association Journal*, Spring 1982.

Pierre R. Crosson

"Diverging Interests in Soil Conservation and Water Quality: Society Vs. the Farmer," in *Perceptions, Attitudes and Risk: Overlooked Variables in Formulating Public Policy on Soil Conservation and Water Quality*, Staff Report no. AGES829129, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., 1982.

"Is There a Crisis in Agricultural Inputs?" in *Food in the Future: Proceedings of a Symposium*, U.S. General Accounting Office, Washington, D.C., 1981.

[With John A. Miranowski] "Commentary: Soil Protection: Why, by Whom, for Whom," *The Journal of Soil and Water Conservation*, January–February 1982.

Joel Darmstadter

(With Thomas J. Lareau) "Energy and Consumer-Expenditure Patterns: Modeling Approaches and Projections," *Annual Review of Energy*, vol. 7, 1982.

Review of *Energy Transitions: Long-Term Perspectives* by Lewis J. Perelman, August W. Giebelhaus, and Michael D. Yokell, eds., in *Environment*, December 1981.

Joy Dunkerley

"The Energy Problem in the Oil-Importing Developing Countries," in Lillian A. Clinard, ed., *Improving World Energy Production and Productivity*, the International Energy Symposia Series, vol. 2, Ballinger, Cambridge, Mass., 1982.

"Energy in Transportation," in *Proceedings of the June 1981 Workshop on Energy and Agriculture in the Developing Countries*, National Academy of Sciences, Washington, D.C., 1981.

"Estimation of Energy Demand: The Developing Countries," *Energy Journal*, vol. 3, no. 2, April 1982.

(With William Ramsay) "Energy and the Oil-Importing Developing Countries," *Science*, vol. 216, no. 4546, May 7, 1982.

(With William Ramsay, Lincoln Gordon, and Elizabeth Cecelski) "Energy, Economic Growth and Development Strategy," *Economic Impact*, no. 37, 1982.

Kenneth R. Farrell

"Food and Agricultural Policy Progam: Resources for the Future," *Food Policy*, vol. 7, no. 3, August 1982.

"Using Models in Policy Formation: Commentary," in *Modelling Agriculture for Policy Analysis in the 1980s*, Federal Reserve Bank of Kansas City, Kansas City, Mo., December 1981.

Winston Harrington

(With David Abbey) "Stationary Source Air Pollution Regulation in the Four Corners States," *Southwestern Review of Management and Economics*, vol. 1, no. 2, Summer 1981.

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Michael Hazilla

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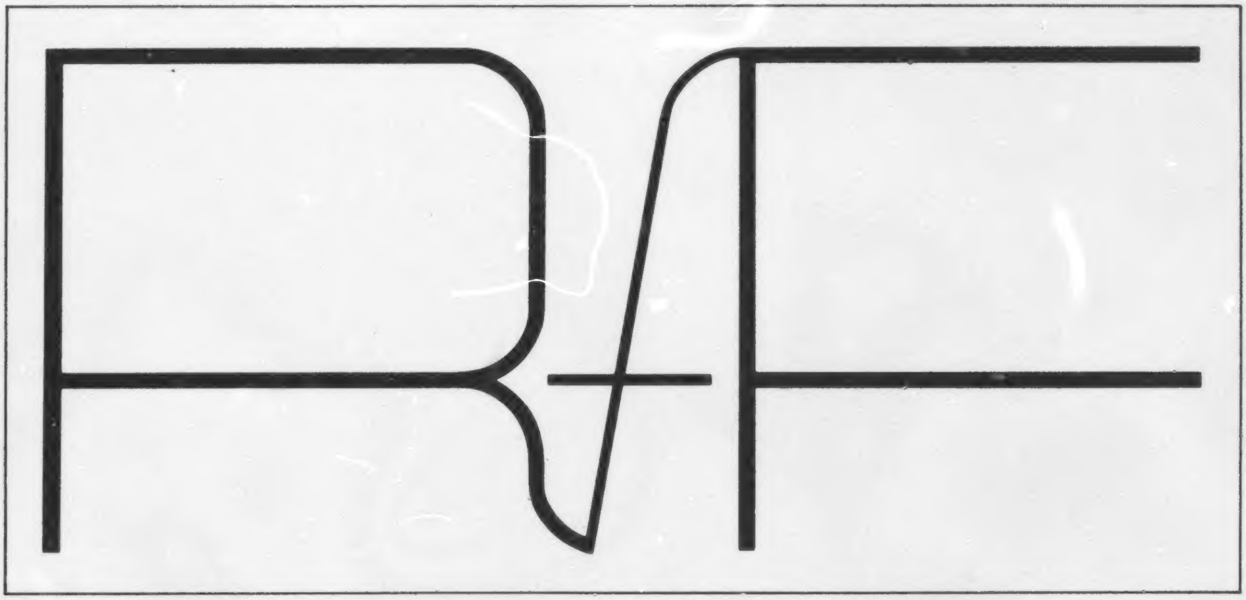
Financial statements



Price
Waterhouse

1801 K STREET, N.W
WASHINGTON, DC 20006
202 296-0800

December 3, 1982

To the Board of Directors of
Resources for the Future, Inc.

In our opinion, the accompanying statement of assets, liabilities and fund balances and the related statements of revenue and expenses and changes in fund balances, of sources and uses of cash and of functional expenses, present fairly the financial position of Resources for the Future, Inc. at September 30, 1982, and the results of its operations and changes in fund balances and sources and uses of cash for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year. Our examination of these statements was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, including at September 30, 1982 confirmation of cash and securities owned by correspondence with the depositaries.

Our examination was made primarily for the purpose of forming an opinion on the basic financial statements taken as a whole. The additional information, included in Exhibits I and II, is presented for purposes of additional analysis and is not a required part of the basic financial statements. Such information has been subjected to the auditing procedures applied in the examination of the basic financial statements and, in our opinion, is fairly stated in all material respects in relation to the basic financial statements taken as a whole.

Price Waterhouse

Statement of assets, liabilities, and fund balances
September 30, 1982
(Notes 1 and 2)

ASSETS

	Operating Fund	Reserve Fund	Total
Cash	$ 82,584	$ 113,722	$ 196,306
Investments, at market value (Note 4)	686,735	20,906,397	21,593,132
Investment income receivable	279,760		279,760
Grants and contracts receivable	640,379		640,379
Other receivables	52,631		52,631
Furniture and equipment, less accumulated depreciation of $220,199	288,888		288,888
	$2,030,977	$21,020,119	$23,051,096

LIABILITIES AND FUND BALANCES

	Operating Fund	Reserve Fund	Total
Grants payable	$ 86,549		$ 86,549
Accounts payable and accrued liabilities	307,507		307,507
Deferred revenue	786,490		786,490
Fund balances	850,431	$21,020,119	21,870,550
	$2,030,977	$21,020,119	$23,051,096

Statement of revenue and expenses and changes in fund balances for the year ended September 30, 1982 (Notes 1 and 2)

	Operating Fund	Reserve Fund	Total
Revenue			
Grants and contributions unrestricted	$ 493,525	$ 429,387	$ 922,912
Grants and contracts restricted	2,886,693		2,886,693
Investment income	102,357	1,788,479	1,890,836
Less - investment and custodian fees	(1,090)	(102,113)	(103,203)
Total revenue	3,481,485	2,115,753	5,597,238
Expenses			
Research programs			
Center for energy policy research	1,265,175		1,265,175
Quality of the environment	1,308,156		1,308,156
Renewable resources	768,138		768,138
Grants	148,881		148,881
Public affairs	346,034		346,034
Administration	1,605,687		1,605,687
Total expenses	5,442,071		5,442,071
Excess of revenue (expenses) before change in market value of investments	(1,960,586)	2,115,753	155,167
Net increase in market value of investments		1,252,340	1,252,340
Excess of revenue (expenses)	(1,960,586)	3,368,093	1,407,507
Transfers between funds	1,686,366	(1,686,366)	
Fund balances at beginning of year	1,124,651	19,338,392	20,463,043
Fund balances at end of year	$ 850,431	$21,020,119	$21,870,550

Statement of functional expenses for the year ended September 30, 1982 (Notes 1 and 2)

	Energy Policy	Quality of Environment	Renewable Resources	Grants	Total Program	Public Affairs	Administration	Total
Salaries	$ 690,991	$ 686,549	$ 383,675	$ 5,306	$1,766,521	$132,218	$ 834,543	$2,733,282
Benefits	160,011	158,600	88,629	1,144	408,384	30,647	207,271	646,302
In-house consultants	21,598	2,304	42,393		66,295	2,250	14,754	83,299
Total salaries and benefits	872,600	847,453	514,697	6,450	2,241,200	165,115	1,056,368	3,462,883
Rent	78,585	76,281	46,078	581	201,525	14,862	102,803	319,190
Data processing	46,546	224,700	20,607	133	291,986	2,942	10,544	305,472
Outside consultants	85,296	110,842	38,412		234,550	22,967	14,830	272,347
Conferences and meetings	2,384	1,363	7,334	27	11,108	9,199	16,075	36,382
Travel	26,459	17,553	30,022	607	74,641	9,289	22,355	106,285
Publications	2,012	4,694	2,291	120	9,117	6,385	8,385	23,887
Book manufacture			50		50	175,342	49,366	224,758
Sale of books						(145,749)		(145,749)
Subcontracts	96,560	1,348			97,908			97,908
Professional services						21,845	44,807	66,652
Depreciation							82,610	82,610
Communication							113,328	113,328
Other	44,733	23,922	15,647	3,818	88,120	63,837	84,016	235,973
Resident fellowships			25,500	42,167	67,667			67,667
Grants and dissertation fellowships	10,000		67,500	94,978	172,478			172,478
Total	392,575	460,703	253,441	142,431	1,249,150	180,919	549,119	1,979,188
Total functional expenses	$1,265,175	$1,308,156	$768,138	$148,881	$3,490,350	$346,034	$1,605,687	$5,442,071

FUNCTIONAL EXPENSES WITH FULL ABSORPTION OF ADMINISTRATION COSTS

	Energy Policy	Quality of Environment	Renewable Resources	Grants	Total Program	Public Affairs	Administration	Total
Total functional expenses	$1,265,175	$1,308,156	$ 768,138	$148,881	$3,490,350	$346,034	$1,605,687	$5,442,071
Overhead - General Fund	266,146	366,037	284,325	5,475	921,983	116,915	(1,038,898)	
Overhead - Reimbursable	300,819	199,089	66,881		566,789		(566,789)	
Total overhead	566,965	565,126	351,206	5,475	1,488,772	116,915	(1,605,687)	
Total on full absorption basis	$1,832,140	$1,873,282	$1,119,344	$154,356	$4,979,122	$462,949		$5,442,071

Statement of sources and uses of cash for the year ended September 30, 1982

Sources of cash	
Excess of revenue over expenses	$1,407,507
Items not using (providing) cash	
Depreciation	82,610
Net increase in market value of investments	(1,252,340)
Cash provided by operations	237,777
Decrease in investment income receivable	43,103
Decrease in grants and contracts receivable	42,817
Decrease in other receivables	45,988
Increase in accounts payable	21,161
Increase in deferred revenues	52,301
Total cash provided	443,147
Uses of cash	
Purchase of securities, net	129,134
Decrease in grants payable	29,003
Purchase of furniture and equipment	113,795
Total cash used	271,932
Cash increase during year	171,215
Cash at beginning of year	25,091
Cash at end of year	$ 196,306

Notes to the financial statements September 30, 1982

Note 1 - Operations

Resources for the Future, Inc. (RFF) is a nonprofit tax-exempt corporation headquartered in Washington, D.C. It was established in October 1952 with the cooperation of the Ford Foundation. Its purpose is to advance the development, conservation, and use of natural resources and the improvement of the quality of the environment through programs of research and education.

Note 2 - Significant Accounting Policies

The operating fund includes those amounts available for current activities. The reserve fund includes those amounts which are income-producing for future operations.

Revenue from restricted grants and contracts is recorded only when costs, chargeable to the specific grant or contract, have been incurred. Amounts which have been received but not expensed are reflected as deferred revenue.

Expenses are recorded when incurred. Grants and subcontracts are recorded as expenses at the time of approval by the directors or the president.

Direct costs are charged to programs on an actual basis. Administration costs (overhead) are allocated to the programs based upon their proportion of direct salaries and benefits to total direct salaries and benefits. The programs have been summarized on a functional basis in the statement of functional expenses. Administration costs of $566,789 were reimbursed under grants and contracts performed within the research programs.

Investments are carried at market value. The net change in market value of investments is comprised of realized and unrealized gains or losses determined by comparison of cost to proceeds or market value, respectively. During the year ended September 30, 1982, RFF incurred a net realized loss of approximately $28,000 from investment transactions.

Furniture and equipment are stated at cost and depreciated over their estimated useful lives on a straight-line basis, ranging from four to ten years.

RFF employees are eligible for participation in RFF's retirement annuity program which is administered through the TIAA/CREF insurance companies. Individual contracts issued under the plan provide for full and immediate vesting of both RFF's and the participants' contributions. RFF's contributions amounted to $322,524 for the year ended September 30, 1982.

Note 3 - Pledges

Exhibit I reflects outstanding unrestricted pledges from foundations and corporations in the amount of $821,500. Of that total, $625,000 is pledged as reserve fund contributions and $196,500 to support operations at RFF.

Payments are anticipated as follows:

	FY 83	FY 84	Total
Reserve fund	$325,000	$300,000	$625,000
Operating contributions	116,500	80,000	196,500
Total	$441,500	$380,000	$821,500

These payments will be recorded as revenue when received.

Note 4 - Investments

A summary of investments held at September 30, 1982 follows:

Operating Fund	Cost	Market
Commercial paper	$ 662,000	$ 662,000
Mutual fund	24,735	24,735
Total Operating Fund	686,735	686,735
Reserve Fund		
Fixed income securities -		
Commercial paper	1,863,000	1,863,000
U.S. Government and U.S. Government Agencies	4,648,735	4,733,484
Corporate bonds	4,056,939	4,095,302
Preferred and common stock	9,950,253	8,949,744
Other	1,500,000	1,264,867
Total Reserve Fund	22,018,927	20,906,397
Total Investments	$22,705,662	$21,593,132

Note 5 - Tax Status

RFF applied for and has received a favorable advance ruling to begin a 60-month termination of its private foundation status as of October 1, 1978 and operate as a public charity as described in Section 509(a)(1) of the Internal Revenue Code. A final determination of RFF's status under Section 509(a)(1) is to be made after the end of the 60-month period. Organizations can treat grants and contributions to RFF as made to an organization described in Section 509(a)(1) unless the organization is aware of RFF's failure to meet the requirements of Section 509(a)(1) or the advance ruling is revoked. Management is not aware of any failure to meet the requirements of Section 509(a)(1) of the Internal Revenue Code.

Note 6 - Commitments

RFF rents office space under a lease expiring on October 31, 1984, which provides for minimum annual rentals adjusted for the level of operating costs. The rental expense for the year amounted to $319,190. Future minimum annual rental payments required under the lease agreement are $359,614.

EXHIBIT I

Revenue from grants, contributions, and contracts for the year ended September 30, 1982 (additional information)

UNRESTRICTED	Total Pledged	Revenue earned Previous Years	Revenue earned Current Year	Balance as of September 30, 1982
Charles Stewart Mott Foundation	$1,500,000	$ 600,000	$300,000	$600,000
The William and Flora Hewlett Foundation	400,000	300,000	100,000	
General Motors Corp.	250,000	100,000	50,000	100,000
Exxon Corp.	345,000	260,000	85,000	
CBS Foundation Inc.	108,000	56,000	27,000	25,000
Laurance S. Rockefeller	100,000		100,000	
Ford Motor Company Fund	100,000	75,000		25,000
Others under $100,000	454,912	122,500	260,912	71,500
Total Unrestricted	$3,257,912	$1,513,500	$922,912	$821,500
RESTRICTED				
Foundations				
The Ford Foundation				
Antarctica in the resource age	$ 25,000	$ 19,112	$ 5,888	
Food and Agricultural Policy Program	80,000	304	79,696	
General Service Foundation				
Forestry Conference	28,500	25,490	3,010	
The Andrew W. Mellon Foundation				
Series of environmental studies	500,000	174,357	50,900	$274,743
Soil erosion and agricultural productivity	150,000	64,620	81,300	4,080
Federal land conference	110,000		66,958	43,042
Natural science fellowships	150,000		564	149,436
Richard King Mellon Foundation				
Land use and spatial economy	250,000	87,114	73,194	89,692
Jessie Smith Noyes Foundation				
Dissertation fellowships in food and agriculture	37,000		37,000	
The Rockefeller Foundation				
Fuelwood study	47,000	16,982	30,018	
Alfred P. Sloan Foundation				
Energy analysis and decision making	270,000	200,000	64,643	5,357
Alternatives to direct regulation	573,500	357,877	132,015	83,608

EXHIBIT I *(continued)*

	Total Pledged	Revenue earned Previous years	Revenue earned Current year	Balance as of September 30, 1982
FOUNDATIONS (continued)				
Weyerhaeuser Company Foundation				
Forest economics and policy program	310,000	132,959	157,508	19,533
Total Foundations	2,531,000	1,078,815	782,694	669,491
Other Institutions				
Association of Environmental and Resource Economists				
Cost reimbursement	10,274	6,120	4,154	
Brookings Institution				
Energy in Northeast Asia	59,942	39,942	20,000	
Energy and national security	480,611	70,015	304,894	105,702
Electric Power Research Institute				
Discount rate conference	71,920	67,318	4,602	
Substitution between energy and other production factors	297,625	262,389	35,236	
Elasticity of energy supply and demand	65,288		1,771	63,517
Gas Research Institute				
Review of post-2000 energy production	22,217		12,666	9,551
Natural gas production from biomass	8,923		8,923	
Jackson Hole Preserve				
Outdoor recreation policy cost reimbursement	5,000		2,700	2,300
Japan Center for International Exchange				
U.S.-Japan agricultural trade project	22,124	5,000	17,124	
Oak Ridge National Laboratory				
Nonenergy mineral supply issues	25,000	403	24,597	
Analysis of long range natural gas issues	54,687		48,430	6,257
Energy related health and environmental research benefits	40,118		15,790	24,328
Organization for Economic Cooperation and Development				
Alternative to direct environmental regulations	3,600		3,600	
Pollution control costs estimates	5,000		4,937	63

EXHIBIT I (*continued*)

	Total Pledged	Revenue earned		Balance as of September 30, 1982
		Previous years	Current year	
OTHER INSTITUTIONS (continued)				
Tennessee Valley Authority				
Electricity in TVA region	20,000		7,623	12,377
Electricity policy project	2,789		2,789	
University of New Mexico				
EVIST project	10,000		10,000	
University of Wyoming				
Nontechnical book on air pollution	22,158		22,135	23
Urban Land Institute				
Forest economics and policy program	10,000		10,000	
Various Mining and Minerals Corporate Foundations				
Mining and minerals economics and policy program	60,151		20,212	39,939
World Bank				
Energy demand in developing countries	33,000		33,000	
Total Other Institutions	1,330,427	451,187	615,183	264,057
Government				
Agency for International Development				
Energy assessment and policy development	1,075,000	825,930	249,070	
Argonne National Laboratory				
Community energy supply and systems planning	54,592		54,592	
Brookhaven National Laboratory				
Imported oil premium	217,400	145,907	71,493	
National Science Foundation				
Environmental asset accounts	149,430	63,626	84,350	1,454
Environmental compliance costs for industry	9,950	5,451	4,499	
Ethical and value dimensions of the nuclear debate	155,412	138,122	17,290	
Valuation of public forest and range land resources	142,463	15,377	32,326	94,760
Office of Water Research and Technology				
Impact upon water conservation in Tucson, Arizona; Incentives, disincentives and pricing	85,133	77,823	3,137	4,173

EXHIBIT I (*continued*)

	Total Pledged	Revenue earned Previous years	 Current year	Balance as of September 30, 1982
GOVERNMENT (continued)				
U.S. Department of Agriculture				
Biomass assessment report	18,166		18,166	
U.S. Department of Commerce - National Oceanic Atmospheric Administration				
Pollutant discharge inventory-Coastal Zone	535,218	236,041	223,689	75,488
U.S. Department of Energy				
Fossil energy technology program	147,072	114,029	33,043	
U.S. Environmental Protection Agency				
Human health benefits analysis	452,416		234,573	217,843
Analysis for integrated waste management	74,284		1,678	72,606
Major environmental espisodes	297,600	42,127	147,291	108,182
U.S. Forest Service				
Forest economics and policy program	1,081,297	529,423	229,264	322,610
Wildland natural resource benefits	7,780	248	7,532	
U.S. Department of Interior Geological Survey				
Water use data analysis	290,776	81,113	62,874	146,789
U.S. Department of Transportation				
Energy impacts of urban transportation	8,000		8,000	
U.S. Department of State				
Energy consumption in developing countries	10,000	4,051	5,949	
Total Government	4,811,989	2,279,268	1,488,816	1,043,905
Total Restricted	$8,673,416	$3,809,270	$2,886,693	$1,977,453

EXHIBIT II

Statement of grants and dissertation fellowships for the year ended Septemer 30, 1982 (additional information)

		Changes During Period		
Small Grants Program	Balance September 30, 1981	Grants awarded	Payments made	Balance September 30, 1982
Arizona State University An examination of the effect of modern environmental legislation on the conduct of operation under the Mining Law of 1872		$12,298	$6,149	$6,149
University of California, Los Angeles The influence of habitat dissections and patchiness in biotic diversity	$30,064		15,032	15,032
University of California, Santa Barbara The value of time and the cost of nonprice rationing	4,968			4,968
Clark University Seabrook: A case history in electricity-environment decision making at the state level		19,985	9,993	9,992
University of Colorado Innovation in water management: An ex-post analysis of the northern Colorado water conservancy district/Colorado-Big Thompson project	15,000		15,000	
University of Connecticut City/suburb relations: Strategic zoning and fiscal behavior study	13,644		13,644	
Emory University The Energy Court: The judiciary and federal energy policy		11,003	5,501	5,502
Hofstra University U.S. stake in global spectrum management: Economic incentives to reconcile divergent cross-national interests	15,000		15,000	
University of Houston Compulsory unitization of oil and gas fields in Texas: The common law and proposals for reform		11,495		11,495

EXHIBIT II (*continued*)

	Balance September 30, 1981	Changes During Period		Balance September 30, 1982
		Grants awarded	Payments made	
SMALL GRANTS PROGRAM (continued)				
University of Kentucky Aggregation problems in benefit-cost analysis of multipart programs		19,960		19,960
State University of New York at Binghamton Cost-benefit analysis of alternative electricity rate structures	5,907		5,907	
University of Tennessee The automatic fuel adjustment clause and fuel purchasing practices in the U.S. electric utility industry	27,280		27,280	
Virginia Polytechnic Institute and State University Psychological field experiment in resource management: Relevance of economic theory and policy	3,689		3,689	
Washington State University Applied resource economics: Theoretical structure and empirical methods of testing and efficiency of extraction with individual firm data		20,237	10,119	10,118
Subtotal	115,552	94,978	127,314	83,216
Forest Economics and Policy Program Grants				
Forest History Society Study of forest economics as a discipline		2,000	2,000	
University of Maryland A legal history of zoning in the Baltimore region		2,500	2,500	
Dissertation Fellowships				
University of Colorado Impact of the U.S. taxation system on the supply of timber		7,500	7,500	
Virginia Polytechnic Institute and State University Optimizing thinning schedules in mixed species even-aged hardwoods		7,500	7,500	
University of Washington The sociological consideration of				

EXHIBIT II (*continued*)

		Changes During Period		
	Balance September 30, 1981	Grants awarded	Payments made	Balance September 30, 1982
DISSERTATION FELLOWSHIPS (continued)				
forest policy decisions		7,500	7,500	
University of Washington An economic model of tree breeding		7,500	7,500	
Subtotal		34,500	34,500	
Food and Agricultural Policy Program Dissertation Fellowships				
University of California, Los Angeles U.S. agriculture in a world context: Policy considerations		11,000	11,000	
Colorado State University Economics of cost-sharing arrangements for the abatement of nonprofit agricultural pollution: Salinity in the Colorado River		11,000	11,000	
Virginia Polytechnic Institute and State University The impact of risk and uncertainty on farmers' decisions to adopt soil conserving management practices in a Virginia watershed		11,000	11,000	
Subtotal		33,000	33,000	
Mining and Minerals Program Dissertation Fellowship				
Pennsylvania State University		10,000	6,667	3,333
Total Grants and Dissertation Fellowships	$115,552	$172,478	$201,481	$86,549

RFF FELLOWSHIP AND GRANT PROGRAMS

Gilbert F. White Fellowships

Bret Wallach and Frank J. Popper are Gilbert F. White Fellows for the 1982–83 academic year. The fellowships were established in 1980 in honor of Dr. White, distinguished geographer and former chairman of RFF's Board of Directors.

The fellowships, awarded annually, are intended for young professionals who wish to devote a year to scholarly work at RFF on social or policy programs in the area of natural resources, energy, or the environment. The program is directed by Herbert C. Morton, senior fellow in the Quality of the Environment Division.

Wallach, an associate professor of geography at the University of Oklahoma, will devote his year at RFF to a study of land and water use in the High Plains.

Popper, an independent consultant and political scientist, will examine planning for locally unwanted land uses, such as hazardous waste disposal.

Natural Science Fellowship

In 1982 the Andrew W. Mellon Foundation made possible the establishment of an RFF resident fellowship in the natural sciences. Its purpose is to inform and broaden RFF's traditional strengths in the social sciences by bringing to the staff persons skilled in the approaches and insights of the natural sciences.

The first Natural Science Fellow is Glen E. Gordon of the Department of Chemistry at the University of Maryland. While at RFF he will study the application of thermodynamics to problems such as determining the amount of energy required to extract and treat mineral resources.

The Albright Fellowship

Early in 1982 RFF established the Horace Marden Albright Fellowship in Public Lands Studies in honor of Horace Albright, a founder of RFF in 1952, its first president, and former chairman of its Board of Directors. The fellowship, to be awarded annually to a professional who wishes to devote time in residence at RFF to scholarly work on social or policy problems involving the public lands, draws its principal support from a grant from Laurence S. Rockefeller.

The winner for the 1982–83 academic year is Michael D. Bowes, a fellow in RFF's Quality of the Environment Division. His work on various aspects of the multiple use of public lands is done in conjunction with RFF's Forest Economics and Policy Program.

The Forest Fellowship

The Forest Economics and Policy Program established a resident fellowship program in 1981 to bring to RFF outstanding persons who wish to devote a year to scholarly work related to the program's objectives.

Christopher K. Leman, assistant professor of politics at Brandeis University, is the Forest Fellow for the 1982–83 academic year. The starting point for his work is Herbert Kaufman's classic study in public administration, *The Forest Ranger*, published for RFF in 1960.

Dissertation Fellowships

The Forest Economics and Policy Program and the Food and Agricultural Policy Program, both headquartered in the Renewable Resources Division, offer programs of support for the completion of dissertations by doctoral candidates in their respective fields.

The winners of 1982 Forest Economics and Policy Dissertation Fellowships are Stephen H. Bullard, College of Forestry, the Virginia Polytechnic Institute and State University; Matthew S. Carrol, College of Forestry, University of Washington; and Villamor Gamponia, Department of Economics, University of Washington.

Those receiving 1982 awards to support dissertations in public policy formulation or administration as they apply to food or agricultural resources include Richard L. Gardner, Colorado State University; Kostas G. Stamoulis, the University of California, Berkeley; and William McSweeney, the Virginia Polytechnic Institute and State University.

The Food and Agricultural Policy Dissertation Fellowships are made possible by a grant from the Jessie Smith Noyes Foundation.

Small Grants

RFF's Small Grants Program is designed to support scholars with an innovative idea in a relatively ignored area of research, or the researchers who need help in bringing a significant research undertaking to fruition. Paul R. Portney, senior fellow in the Quality of the Environment Division, is director of the program.

The recipients of 1982 grants, their affiliations, and topics are:

Dennis Ducsik, Clark University, Worcester, Massachusetts, "Seabrook: A Case Study in Decision Making at the State Level"

Jeffrey Krautkraemer, Washington State University, "Applied Resource Economics: Theoretical Structure and Empirical Methods for Testing the Efficiency of Extraction"

John D. Leshy, Arizona State University College of Law, "The Mining Law of 1872 After 110 Years—Alive, but Is It Well?"

Alan Randall, University of Kentucky, "Aggregation Problems in Benefit–Cost Analysis of Multipart Programs"

Thomas Walker, Emory University, "The Energy Court: The Judiciary and Federal Energy Policy"

Jacqueline Weaver, University of Houston Law Center, "Compulsory Unitization of Oil and Gas Fields in Texas: The Common Law and Proposals for Reform"

SOURCES OF SUPPORT

RFF is supported by foundation and corporate sources that provide unrestricted funds for general institutional support, and by foundation and government funds restricted to use for a particular program or project. In addition, an important segment of general support is derived from investment income from RFF's Reserve Fund, which functions as an endowment.

Corporate unrestricted giving amounts to a relatively small percentage of total support, but it is a growing fraction and one increasingly vital to the maintenance of a margin of excellence. Such support from corporations is not sought in terms of philanthropy, but rather in terms of investment: firms invest in the future of RFF because they perceive in RFF research direct value and benefits, to themselves and to the country at large.

RFF does not accept support from individual corporations for specific research projects, nor does it perform proprietary research. However, funding from corporations in partnership with government and foundation grants to support broad program areas is desirable. Programs benefiting from this form of restricted support from corporations are the Forest Economics and Policy Program, the Minerals Economics and Policy Program, and the Food and Agricultural Policy Program.

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